HEATING & VENTILATING
AIR CONDITIONING

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FOR APRIL, 1937

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For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning.

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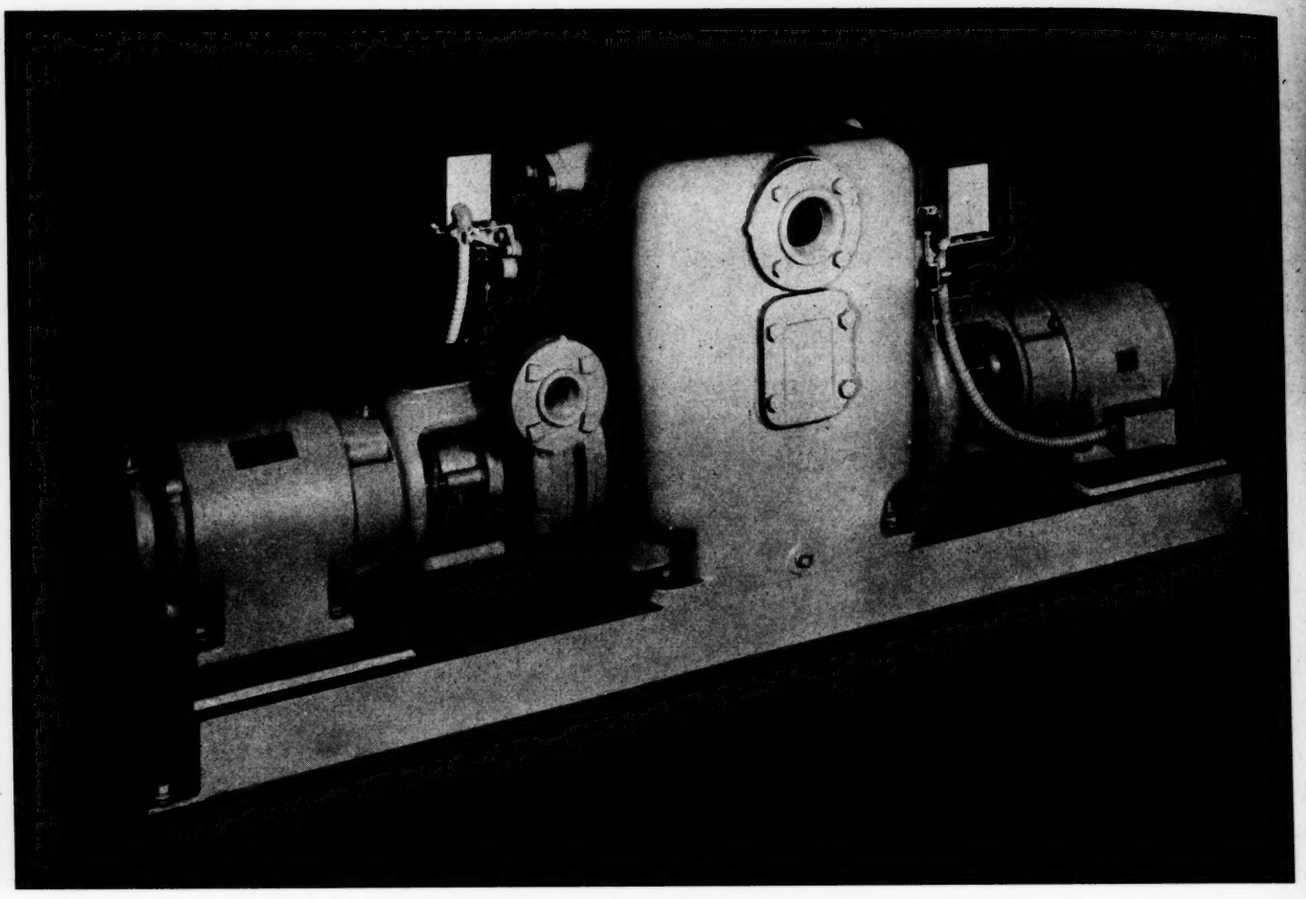
MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



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Degree-Day Assists in Operating Heating Plant at Cincinnati General Hospital

Part 1—The Heating and Power Plant

By ANTHONY A. FETTE†

THE site of the Cincinnati General Hospital covers 65 acres with 30 acres developed in which are situated 28 buildings from one to five stories in height and with an additional building under construction. These buildings consist of 11 ward buildings, one outpatient building and the medical college with a new annex, the Holmes hospital, and other auxiliary buildings. Space is provided for 10 additional buildings. The number of bed patients of the hospital averages over 800 per day during the past few years and several times has hovered near the 1000 mark.

Table 1 shows the buildings arranged in groups and gives volume heated, amount of heating surface installed, and the B.t.u. equivalents of the installed heating surface.

The general hospital was not erected all at once but buildings have been added from time to time. For instance, since 1928 the volume of space added is 1,156,751 cu. ft., representing 12.13% increase in volume. During that same period 29,997 sq. ft. of radiator surface have been added, or an increase of 22½%. Radiator percentage increases faster than the volume percentage increases due to the fact that boiler and engine room have no heating radiators and neither do the tunnels which accommodate the various services and neither do some of the auxiliary buildings such as kitchens and bakeries.

The general hospital now has 10,715,593 cu. ft. of interior volume including refrigerated rooms and 10,688,668 cu. ft. not including refrigerated rooms; also there are 812,100 sq. ft. of floor space including refrigerated rooms and 809,642 sq. ft. of floor space not including refrigerated rooms.

The steam generating plant at the hospital is charged with the duty of

The heating and power plant at the Cincinnati General Hospital is a good example of an institutional plant extended from time to time as necessary and operated to secure maximum economy. With a hot water heating plant operated in strict accordance with outside temperature changes, the heat consumption would be expected to parallel outside temperature almost exactly. Use of the degree-day as a yardstick for measuring results in such a plant is a "natural." But with the plant being started at 60F outside temperature instead of the 65F often used elsewhere, a whole new set of degree-day figures based on 60F was developed for this plant. With this information at hand the degree-day was applied to the daily operations by furnishing the operators with simple tables and forms.

The degree-day application can not be followed to advantage without a knowledge of the principal features of the plant and its operation. This article describes the plant, while one to follow will deal with the use of the degree-day.—Editor.

†Mechanical Director, Cincinnati General Hospital.

TABLE 1

Group	Volume Heated		Radiation		B.t.u. Load	
	Cu. Ft.	%	Sq. Ft.	%	B.t.u.	%
General Hospital Group	7,081,815.12	68.19	102,479	62.93	19,129,340	63.52
Contagious Group	933,676.68	8.99	18,613	11.43	3,474,460	11.53
Medical College Group	1,914,670.83	18.44	33,187	20.38	5,973,660	19.83
Holmes Hospital	454,914.72	4.38	8,573	5.26	1,543,140	5.12
Totals	10,385,077.35	100.00	162,852	100.00	30,120,600	100.00

furnishing a number of services of which heat for the buildings is only one. The direct services include compressed air, laundry, cooking, sterilizing, heating and furnishing domestic hot water, ice and refrigeration, and electric power. Thus the central power plant of the hospital is a combined heating and power plant.

total steam generated at the power plant is shown in column 18 of Table 3.

As the generating plant operates throughout the year, it is necessary to supply steam for heating during the summer season and the amount of this steam is shown in column 2 of Table 2. Throughout the year the steam

TABLE 2.—STEAM ACTUALLY USED, INDIRECT STEAM, AND TOTAL STEAM REQUIRED IN SUMMER, WINTER, AND ANNUALLY, FOR HEATING BUILDINGS ONLY

Year	Summer Season			Heating Season			Annual		
	Actual, Lb.	Indirect, Lb.	Total Lb.	Actual, Lb.	Indirect, Lb.	Total Lb.	Actual, Lb.	Indirect, Lb.	Total Lb.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1929.....	3,064,321	349,854	3,414,175	49,972,049	2,528,889	52,500,938	53,036,370	2,878,743	55,915,113
1930.....	2,058,196	530,987	2,589,183	62,333,995	4,359,099	66,693,094	64,392,191	4,890,086	69,282,277
1931.....	6,411,531	1,017,616	7,429,147	64,726,210	3,659,949	68,386,159	71,137,741	4,677,565	75,815,306
1932.....	5,943,564	1,325,389	7,268,953	70,332,243	3,762,481	74,094,724	76,275,807	5,087,870	81,363,677
1933.....	3,862,092	545,485	4,407,577	68,230,318	2,657,414	70,887,732	72,092,410	3,202,899	75,295,309
1934.....	1,552,513	217,689	1,770,202	62,333,995	4,359,094	66,693,094	66,993,342	3,384,309	70,377,651
1935.....	2,445,307	269,424	2,714,731	58,481,162	2,827,234	61,308,396	60,926,469	3,096,658	64,023,127
Total...	25,337,524	4,256,444	29,593,968	439,516,806	22,961,686	462,478,492	492,072,460	27,218,130	492,072,460
Average.	3,619,646	608,063	4,227,709	62,788,115	3,280,241	66,068,356	70,296,065	3,888,304	70,296,065

Both Live and Exhaust Steam Used

Since the hot water is heated by steam obtained from the generating plant, it is of interest to know how much live steam is used annually and how much exhaust steam. Relative quantities and proportions for the past seven years are shown in Table 3. It will be noted that the average over the seven-year period of the exhaust steam made up nearly 26% of the total steam required for heating while the live steam made up 74%. The importance of the heating load as a fraction of the

actually used for heating the water has to be increased by charging against the building heating its proportionate share of steam for operating pumps and auxiliaries in the power plant. Steam used for this purpose is called "indirect" in Table 2.

Cost of Heating

Table 4 shows the cost in dollars for operating the power plant during recent years and also the proportion of this cost chargeable to building heating. It will be

TABLE 3.—QUANTITIES AND PROPORTIONS OF LIVE AND EXHAUST STEAM USED ANNUALLY

Year	Exhaust Steam			Live Steam				
	Lb. Available for Heating Buildings	% of Annual Total Heating Steam Col. 12 ÷ Col. 10	% of Annual Steam Generated by Plant Col. 12 ÷ Col. 19	Lb. Added to Exhaust to Heat Buildings Col. 10 — Col. 12	% of Total Annual Steam to Heat Buildings Col. 15 ÷ Col. 10	% of Annual Steam Generated by Plant Col. 15 ÷ Col. 19	% Annual Total Heating Steam is to Total Steam Generated	Total Annual Lb. of Steam Generated by Plant
(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
1929.....	4,098,586	7.33%	2.49%	51,816,527	92.67%	31.43%	33.92%	164,847,000
1930.....	15,780,046	23.07%	9.08%	53,502,231	76.93%	30.79%	39.87%	173,779,340
1931.....	20,283,271	26.75%	11.36%	55,532,035	73.25%	31.09%	42.45%	178,582,850
1932.....	20,206,242	24.83%	10.90%	61,157,435	75.17%	33.03%	43.93%	185,144,960
1933.....	23,982,272	31.85%	13.69%	51,313,037	68.15%	29.29%	42.98%	175,202,920
1934.....	21,480,242	30.52%	12.36%	48,897,409	69.48%	28.13%	40.49%	173,839,100
1935.....	22,048,597	34.44%	12.70%	41,974,530	65.56%	24.18%	36.89%	173,531,620
Total.....	127,879,256	—	—	364,193,204	—	—	—	1,224,927,790
Average....	18,268,465	25.99%	10.44%	52,027,600	74.01%	29.73%	40.17%	174,989,684

noted that over the period the average cost of building heating has represented 40% of the total cost of operating the power plant.

The Heating System

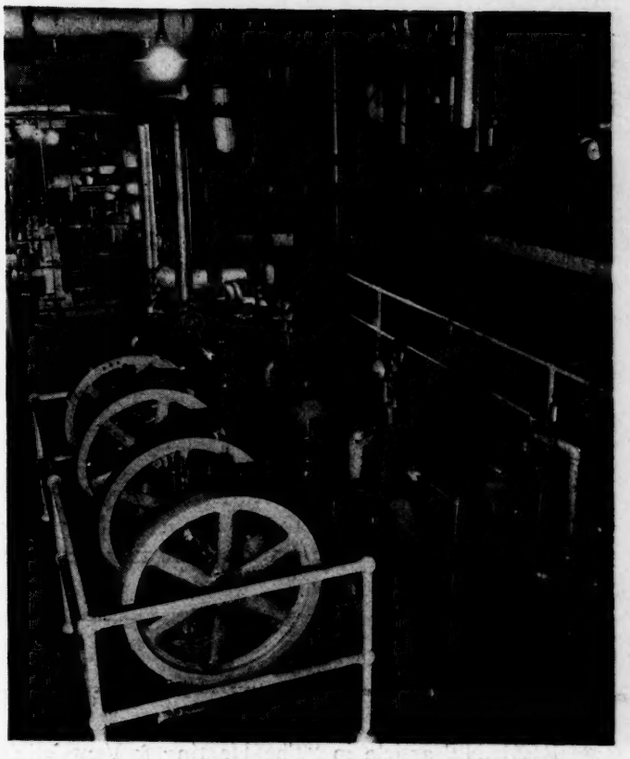
Heat is furnished to the whole group of buildings by a central hot water circulating system. The hot water is heated at the power plant by passing steam through heat exchangers. The general plan of operation is to make use of exhaust steam to supply these heat exchangers so far as possible. When there is not enough exhaust steam to supply the buildings with heat, live steam is used to make up the deficiency.

The hot water system is used principally because of the large area covered by the buildings, the desire for uniform heat, and in order to keep a low back pressure in the exhaust steam lines. If steam mains were used to distribute the heat to the buildings, a considerable back pressure would have to be carried in the exhaust pipe in order to push the steam over the 30 acres and through the 28 buildings.

Forced circulation is used to drive the hot water through the distribution system and is set up by three centrifugal pumps driven by steam turbines. The circulating pumps are operated only when heating is required at the buildings. The plant never has sufficient exhaust steam for heating even in the mildest weather and the exhaust steam from the pump turbines helps to make up the deficiency in the exhaust steam supply.

Heating of the water is controlled by varying the number of turbines operating and also by changing their speed. The heat exchange can be increased slightly by speeding up the turbine, thus securing a greater velocity in the circulating water and a faster trip through the distributing system. This speeding up produces more exhaust from the turbine available to add heat to the water.

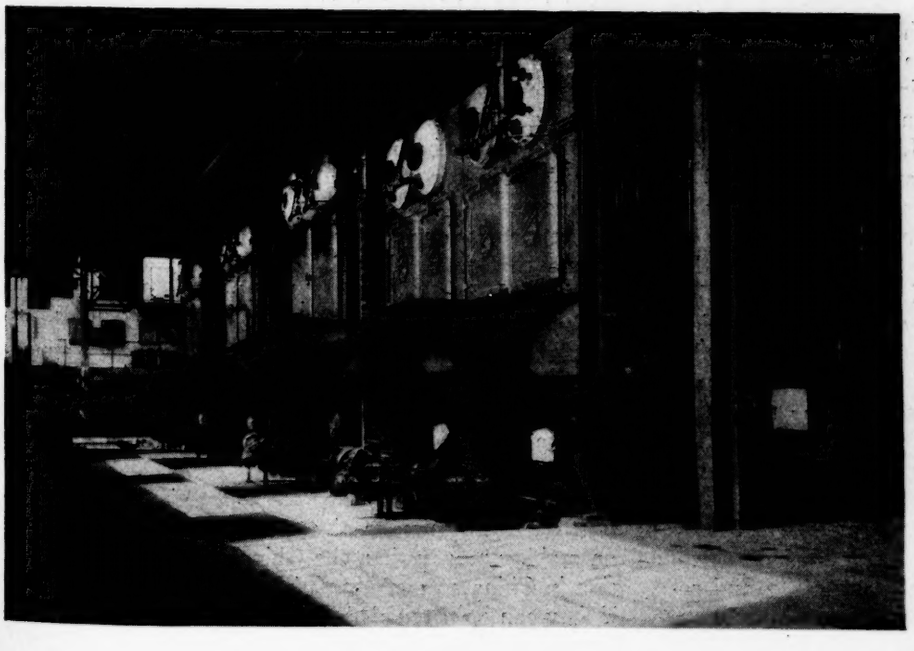
The heat exhaust is further increased by starting up another turbine which increases the velocity of the circulating water still more and supplies still more exhaust steam for heating. Finally, when all three turbines are operating at top speed and do not maintain the required temperature, live steam from the boilers is turned directly into the exhaust lines.



Equipment room with hot water heating tanks shown at the top center

It is interesting to note that these steam turbines have now operated over 20 years and are still in excellent condition. All were opened up recently and the blades indicated little wear while other parts were found to be in good condition.

There are three exhaust steam heaters and two live steam heaters available for heating the circulating hot water. The heaters are installed in the engine room and all the heat transfer to the water takes place in a radius of less than 50 feet of the boilers and engines. These heaters were designed to care for 300,000 sq. ft of direct radiator and since the present connected load is 162,852 sq. ft., only 54% of the installed capacity of the heaters is in use. It has never been found necessary to use the live steam heaters to take care of the present load.



Stoker-fired boilers in the central power plant

TABLE 4

Year	Total Power Plant Costs per Year, Dollars	Heating Cost Per Year, Dollars	% of Total Cost for Heating
1929	61,751.68	20,945.82	39.9
1930	64,381.03	25,667.40	39.9
1931	60,217.24	25,564.53	42.5
1932	57,611.76	25,318.01	43.9
1933	52,275.84	22,466.10	43.0
1934	59,901.00	24,250.55	40.5
Total....	356,138.55	144,212.41	—
Average..	59,356.42	24,035.40	40.5

Distribution System

The hot water leaves and returns in two directions —one to east and another to the north of the power plant. The east branch consists of 14-in. lines and the north branch of 12-in. The main lines in the power plant are of 16-in. pipe. The east branch serves 19 buildings having 62.56% of the heating load, while the north branch serves 9 buildings having 37.44% of the total heating load.

The supply and return branch from the main header to each building has a gate valve on each line. The return line has an additional line without a hand wheel, there being a square nut on the stem instead of a wheel. The velocity of the water through each building is regulated by adjusting this nut. These adjustments were made in the early years of operation and are now almost never changed. There is also a thermometer on both the supply and the return pipe of each building.

In calculating the load at the plant 180 B.t.u. per hr. are allowed for each square foot of cast iron and 220 B.t.u. per hr. for each square foot of pipe coil. Of the 162,852 sq. ft. of heating surface, 87.7% is of cast iron while the remainder is in the form of pipe coil.

Air Conditioning in the Tropics

A RECENT article in "The Heating & Ventilating Engineer" (London) by Prof. C. A. Middleton Smith of the University of Hongkong discussed the need and market for air conditioning in the tropics. Abstracts from the article follow:

About one-third of the area of the earth is within the tropics. The British Empire includes a vast area of tropical land. Unfortunately, after a time, the climate in the tropics invariably saps the vitality of Europeans. Countless fiction stories, and records of actual fact, remind us that many a white man has degenerated under the influence of a tropical climate. The temptation to overcome mental inertia or depression by taking alcohol is great and even excusable. But the artificial stimulant gives only a temporary relief which, in many cases, produces a yet greater depression when the inevitable reaction sets in.

In a hot and humid climate the human body loses moisture much more rapidly than in an ideal climate, and that provokes thirst. Experiments showed that a man, sitting in a restful position, in an ideal climate lost 0.095 lb. per hr. body weight. In a climate of 98.6F dry bulb thermometer, and 75F wet bulb, he lost 0.24 lb. A collier, pressed by an increase in heat and humidity, lost 5.8 lb. per hr. by sweating. Doctor Hunt, in India, relates that when playing tennis, he lost 4 lb. per hr. as against the loss of 2 lb. in the Oxford Turkish bath. It is noticeable that Chinese coolies, in the tropics, working all day, sweat freely, but drink only warm tea. It is a fact that under modern and more hygienic conditions, the decadence of Anglo-Saxons in the tropics is becoming rare; but it still remains true that the hot and humid climate saps their energy, if not their moral fibre.

The majority of Europeans after many years of residence in the tropics, can perhaps be divided into two classes, viz., those who take things very easily and so conserve their energy and health, and those who rely on stimulants to make them "buck up." There are, of course, some men of great vitality outside those classes, but everyone is affected by the excessive humidity.

Owing to the granite formation of the island of Hongkong, which has steep hillsides rising almost abruptly to a height of nearly 1800 ft., the humidity at times reaches the saturation point. A moist fog envelops many residences. The air from the equatorial regions to the south absorbs moisture as it travels hundreds of miles over the sea. This moisture condenses when the air strikes the granite rock on (and in the mainland opposite to) the island of Hongkong.

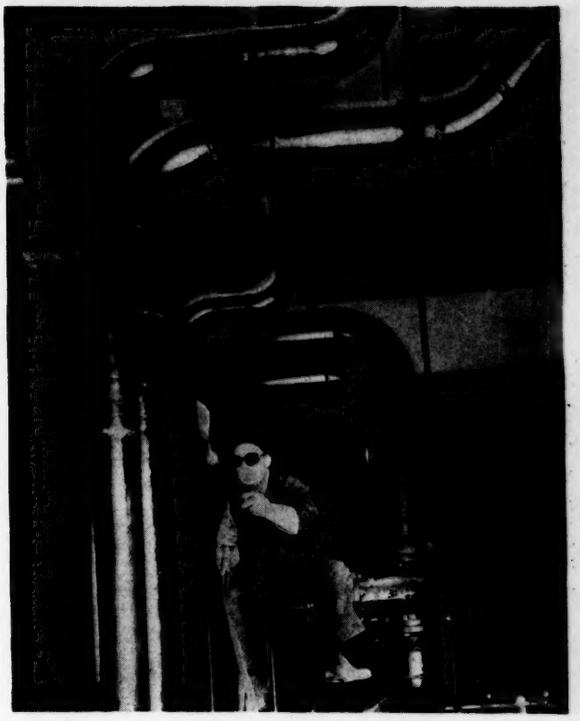
Very few residents in this British Colony understand the above simple explanation of a natural phenomenon which causes them great discomfort. The moist fog, in the average, envelops houses on the higher levels in Hongkong for rather more than 100 out of the 365 days of the year. It penetrates into homes, with most unpleasant results. Residents often light fires with an atmosphere at 88F, so as to dry the room. Houses are fitted with "hot rooms," i.e., rooms artificially heated so as to reduce humidity where clothes are stored. Obviously, air conditioning is the real solution of the problem.

Let me give one example of a great industry in South China that would benefit immensely from air conditioning. It is the (real) silk industry. Every year a big proportion of the eggs of the silkworms fail to hatch out. It is reasonable to believe that varying atmospheric conditions cause the failure. A demonstration of the effect of air conditioning upon these eggs, with definite figures, would possibly create a most valuable new market for manufacturers.

The Chinese silk growers are said to be conservative, but, make no mistake about it, no people are keener on making money than the Chinese. The new generation in China are eager to adopt new scientific methods if they can be persuaded that it will pay them to do so.

Pipe Welding Simplifies Design and Lowers Cost

Pipe welding is today used in the majority of new piping installations both large and small. This article summarizes the recent developments which have brought about this popularity of welding; it discusses the ASA code, the availability of welding end valves, outlines advantages in layout and erection, offers suggestions for preparation of drawings and specifications, and advises what piping to weld. The article is presented through the courtesy of the Linde Air Products Company, unit of Union Carbide and Carbon Corporation, New York.



A clean-cut steam piping installation—excellent in appearance, easily insulated, and good for the life of the pipe

GENERAL acceptance of the welded joint for most types and sizes of building and industrial piping has been an outstanding occurrence in the construction industry during the past fifteen years. But why is it still necessary to say most types and sizes? Has not welding, with all its advantages, been accepted for *every* classification of piping and *every* size?

Until recently there were sometimes good reasons why welding was not employed to the fullest extent—reasons that were peculiar to a particular locality or that were a result of past circumstances. Possibly there was a shortage of experienced workmen to do the welding, or the knowledge of just how to use welding effectively was lacking. Costs may have seemed to be high. Possibly welded joints were tried for a certain type of service and results were disappointing. Perhaps there seemed to be insufficient precedent for using welding.

But situations such as these are not unchanging. In the past few years alone several developments have occurred which are almost certain to improve further the status of welding—by giving greater assurance of dependable work, by making it easier to design for welding, and by lowering costs. When these are added to the other prominent developments of the past five to eight years, the total result is of vital importance to all who are concerned with piping.

It has been common practice for over ten years to weld underground steam mains—especially those laid under city streets from central steam plants. Today, the great majority of new installations and extensions are welded—even to welding valves and expansion joints directly to the pipe. Medium- and low-pressure steam piping in power plants and factories is customarily welded. It may safely be said of important buildings constructed in recent years that more than 50% have steam lines installed principally by welding.

For Smaller Installations

This does not mean that welded heating installations are limited to the larger buildings. Some heating contractors make a specialty of welded installations for smaller buildings where pipe sizes range from ½ in. to 6 in. in diameter, and find it practical to weld all sizes. As a general rule, however, steam piping under 2 in. in diameter is not welded, due chiefly to high labor costs. But with efficient organization it has been shown that all sizes can be welded without appreciably increasing overall costs on a job.

Recent Developments

For those who prefer to specify that important work be carried out in accordance with a recognized construction code, the new tentative Code for Pressure Piping will fill the need. It was approved in June, 1935, by the American Standards Association, and is sponsored by the American Society of Mechanical Engineers. The Code represents a standard of minimum requirements for materials, dimensions, design, erection, and testing of completed systems. It treats welding in detail and permits its use for all temperatures and pressures for which the pipe being used is suited.

New tentative standards for steel and wrought iron pipe, introduced by American Standards Association in 1935, give promise of important savings in pipe material where welding is used, particularly in the 8-, 10-, and 12-in. sizes. The standards call for some lighter weight pipe in these sizes, to be in addition to weights available at present. The new weights have a ¼-in. wall

thickness, are unsuited for threaded joints, but are readily welded.

Another development of the past few years is the availability of valves and expansion joints having cast steel or wrought steel ends for welding directly to pipe. Thus, if desired, all flanges on an installation may be eliminated. Steel fittings for welding into a piping system, such as welding elbows, tees, reducers and heads, have been available for a number of years and have made possible what are, in effect, systems of closed tubes equally strong in all parts.

What Piping to Weld

Services and sizes to be welded will depend in many instances on the economics of the welding job. In other cases safety, low maintenance or trouble-free operation will be the determining factor. For example all oil, gas, and refrigeration piping should have as few mechanical joints as possible so as to eliminate chances for leaks and resulting hazards. All sizes of underground piping, process piping, and concealed steam piping should be welded to avoid expensive shutdowns and repairs which might be required if mechanical joints gave trouble.

When first cost is a consideration in the installation of piping, sizes to be welded will depend on the cost estimates of piping contractors or whatever organization is going to do the work. If desired, estimates or alternate bids may be requested for welding all sizes and for welding pipe above a certain minimum size, in order to arrive at the best possible contract. Since it is safe to assume that welding will double the life of joints in small diameter pipe and cut maintenance to the minimum, there is this value to balance against the expense of a completely welded installation.

Freedom in Layout

One of the primary advantages of welding is a greater freedom in general design and layout, and the many possibilities which permit this should not be overlooked. Changes in direction, for example, can be made at any desired angle, and at any radius of turn from a sharp right angle to a long sweep bend. The variety of branch connections possible is as great as the number of ways in which one pipe can intersect another. In addition to the standard welded tee—a branch connection at right angles to the main—connections can be made at various angles from the perpendicular. Branch connections also can be eccentric with the main, and this is often an advantage in gaining headroom. Flexible layout for expansion and contraction movements is readily obtained.

Sweep tees permit efficiency of flow and compactness of layout impracticable with mechanical joints. Another compact branch connection is the welding elbow welded directly to the main, eliminating the nipple usually provided in between. Where available space is at a premium, welding compacts the bulk of piping to an irreducible minimum. Care must of course be taken so that installation will not be made too difficult.

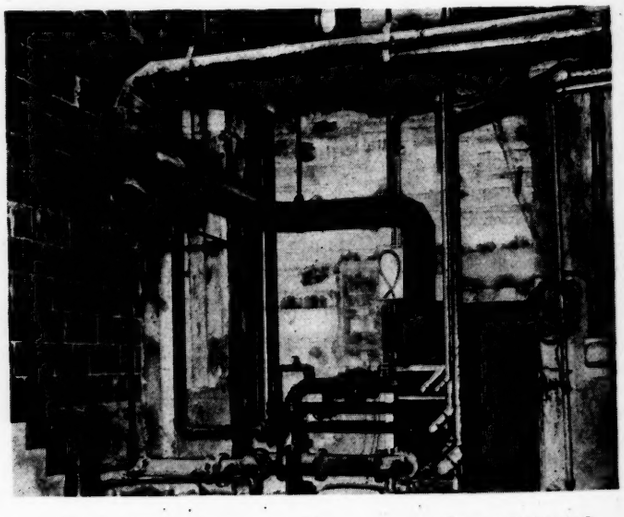
Welded Joints and Fittings

For line joints, the single vee butt weld is invariably used. This is the joint employed for connecting straight lengths of pipe, and for connecting welding fittings to pipe or to each other. This weld is indicated simply by drawing a line square across the pipe on two-line drawings, and by a large dot on single-line drawings.

Fittings manufactured specially for welding into piping systems are now available for practically every requirement. They are specified in particular where flow efficiency is an important factor; for high-pressure, high-temperature services; where piping is exposed and good appearance is a consideration; and where operators experienced in fabricating welded fittings for low-pressure service are not available.

Before welding fittings were to be had, fittings were fabricated on the job or in the shop from pipe by cutting and welding. This type of construction has been uniformly satisfactory where workmen have been properly trained to make the fittings, and it is still used to a considerable extent, especially in low-pressure service. Special cutting machines have been developed to facilitate fabrication of welded fittings from pipe and quite a few important steam heating installations have been

Welded piping can be shop-fabricated in sections to exact dimensions, assuring positive and speedy installation on the job



Elbows for low-pressure lines are readily fabricated by pipe fitters having considerable experience in welding

made with these welded fittings. Tees reducing on outlet, in particular, are more economically fabricated by cutting and welding.

Drawings and Specifications

Confusion on the job is eliminated if connections to be welded are clearly shown on the drawings or are definitely listed in the specifications. It is a simple matter to indicate welds and welding fittings on either single line or two-line drawings, using certain easily recognized symbols.

Whether or not to prepare detailed welding specifications is frequently a problem. Unless every contractor to whom the job might be awarded can be depended upon to carry out the welding part of the job intelligently, it will be well worth while to prepare detailed specifications as a guide for both the contractor and the inspector. Bidding will be facilitated if the contractor knows just what is expected of him and there will be little chance for disagreement with the inspector.

Points usually covered in a welding specification are: method of welding; sizes of piping and services to be welded, unless this is clearly shown on drawings; type of welding fittings or welded fittings to be installed; grade of welding rod; preliminary test of welds to determine workmen's ability; preparation of joints for welding; welding procedure; and final test.

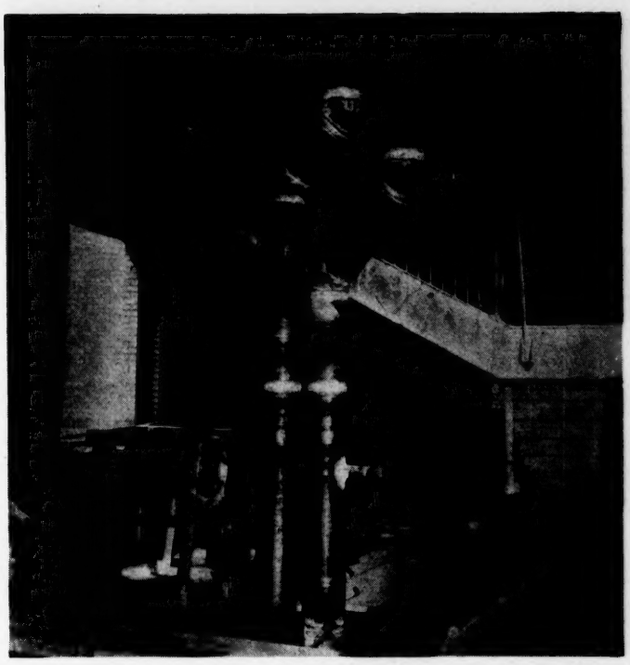
A fundamental advantage of welding to be considered when drawings and specifications are being made up, concerns the general plan for fabrication and erection of the piping. If desired, all the piping on the job can be shop fabricated to exact dimensions with assurance that sections will fit when they reach the job. This is an especially convenient plan if many welded fittings such as branch connections are required since the work can be done more rapidly and properly under shop conditions, and erection will require a minimum of work.

If, on the other hand, it is preferred to do all the welding on the job, rapid erection is possible by utilizing stock welding fittings. For most connections, these fittings are welded into the system with the simple butt type line joint—the easiest and simplest weld of all to make. On the other hand, simple welded fittings require but a little additional time to fabricate on the job and this work can be done separately in advance of erection if desired. Either of these alternatives will probably be the easiest plan to follow for the usual building piping installation.

The Field Shop

On piping jobs which are complicated in layout, involving closely nested lines, and numbers of headers, turns and branch connections, it will be best to have the pipe fabricated in a field shop at the job, or in the shop of a company specializing in this work. Every section of piping containing a turn, branch connection or attachment of any sort is detailed on drawings for shop fabrication, leaving only straight runs of pipe and flanged accessories which do not go through the fabricating shop. Overall dimensions of fabricated sections are kept within reasonable limits for ready handling.

Under such a plan, sections of the system come from the welding shop to the pipe erecting crew completely



The advantages of welding are obtainable with piping made of practically any commercial metal. These 10-in. red brass lines for an air-conditioning system are bronze-welded

fabricated, and the pipe fitters can then put all their attention on erection and making the necessary tie-in welds. This greatly increases the efficiency of the field crew and expedites all phases of the construction job. It is absolutely necessary to follow this plan in some instances so that piping installation may keep pace with other work in the construction of large plants. This method of piping construction is comparable to the detailing, fabrication and erection of structural steel.

Workmen Available

The question of trained workmen for welding work sometimes arises. Pipe fitters' unions, especially in the larger cities throughout the country, are taking active interest in welding, have formed and fostered welding schools, and in many locals highly competent pipe welders are to be found. If the contractor is unable to obtain an adequate supply of pipe fitters experienced in welding from this source, he may, in a comparatively short period, train some of the more progressive of his regular workmen. In this case service offered by the welding material supplier can be of great value both in actual training and in checking procedures.

Although it is usually desirable that every pipe fitter on a welding job be able to weld satisfactorily, this is not absolutely essential. Most pipe fitters can very quickly learn to oxy-acetylene cut pipe and clamp or tack-weld joints or fittings in position ready for welding. The welds can then be made by the pipe fitter most competent to do so.

It will be found that one pipe fitter welding will keep up with three or four fitters flame cutting pipe to length, putting pipe in place, and tack-welding joints. The actual time and material cost of welding pipe joints will also be found to be a relatively small part of the whole job. Thus it is important to have the erection phases of the work organized for greatest efficiency.

Measuring the Odors in Air Conditioned Structures

By V. A. GANT† and H. D. SHAW‡

A new and relatively simple method of measuring the concentration of odors in room air by freezing out the odorous substances has been developed by the authors of this article. The method gives definite values to odor concentrations which values can then be used to compare the odors of various rooms. This material has been abstracted from a paper by the authors in "Industrial and Engineering Chemistry"

IN air conditioning any structure where fresh air and recirculated air are utilized, in time the odor concentration will increase to the point where it is very objectionable, and may present a health hazard and industrial problem. It then becomes necessary to remove the odor or its cause. If complete removal is impossible, the odor concentration should be reduced to the point where it is no longer noticeable.

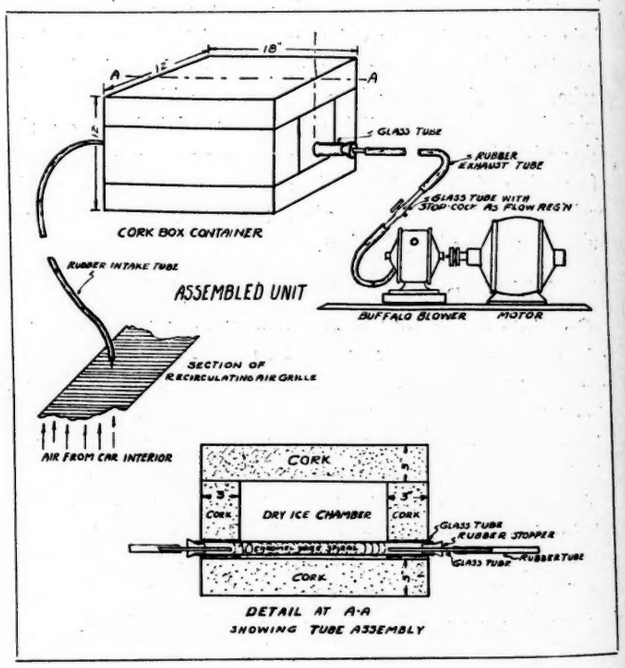
Complete air conditioning involves the control of temperature, humidity, dust, and odors. These factors cannot be controlled satisfactorily unless we have scientific and practical proof as to the efficiency of the equipment. Temperature can be observed on a thermometer, humidity on the hygrometer, and dust by suitable dust-counting apparatus. Methods are known whereby odorous substances known to exist in the air can be determined quantitatively, but information obtained in this way is not satisfactory for obvious reasons. The odors may be so complex and derived from so many different sources that simple chemical determinations of one or more odoriferous substances may represent only a small percentage of the total amount present.

Determination of the total odor concentration and quantitative estimation of certain odor-bearing materials were attacked in the following manner:

A box of 3-in. cork insulation was constructed to hold enough solid carbon dioxide (dry ice) to last 40 to 45 hr. A 1-in. Pyrex glass tube about 19 in. long containing a chromel wire spiral to serve as a condenser, was inserted through closely fitting holes bored in each end of the box as near as possible to the bottom inside. This tube was fitted with one-hole rubber stoppers at each end, through which passed smaller glass tubes for connecting to rubber tubing. Pulverized dry ice was packed in the bottom of the box, enough to cover the condenser tube, and two solid cakes were sawed to fit and completely fill the remaining space inside the box. The box was tightly strapped and any noticeable leaks were stopped with asbestos fiber.

A railroad car of the club lounge type was used for the tests. In the car selected eating, drinking, smoking, and sleeping were in almost constant progress while the car was in use. The air was composed of about 25% fresh air and 75% recirculated. Large proportions of tobacco smoke, and the odors of food, liquor, and human bodies from the bedrooms and lounge were drawn directly into the recirculated air intake. The condition of the atmosphere during and after a trip is best described by likening it to that of an improperly ventilated room where persons have been eating, drinking, and smoking while playing cards.

A long rubber tube was connected to the intake end of the box condenser tube and was allowed to hang over the recirculated air grille inside the car. To the outlet end of the condenser tube another rubber tube was connected which led to a glass tube containing a stopcock for regulating the rate of air flow. This was connected by rubber tubing to the intake nozzle of a small compressor and blower. Thus a sample of recirculated air was drawn through the condenser tube, and the moisture and odor were frozen out as a cone of porous ice 3 or 4 in. long. To determine the flow of air, a calibrated manometer was connected on the outlet side of the condenser tube. The glass stopcock was so adjusted that the rate of flow was 61.02 cu. in. (1



Apparatus for freezing-out method of odor determination.

†University of Illinois College of Medicine.
‡The Pullman Co., Chicago, Ill.

liter) per min., and then the manometer was disconnected. Knowing the length of time that the test was allowed to run it was a simple matter to calculate the amount of air that had passed through the tube.

A rate of 1 liter per min. was used because tests in the laboratory showed that such gases as ammonia, methylamine, acetone, alcohol, and hydrogen sulfide were completely condensed in the first fourth of the intake side of the tube and no traces could be detected coming from the outlet end.

At the end of about 45 hr. the rubber tubes were disconnected and the condenser tube was tightly stoppered and taken to the laboratory in the box containing the remaining dry ice. The tube was then taken out of the box and the frozen odor and moisture were placed in a wide-mouthed bottle, properly fitted with a cork collar through which was inserted a Fair osmoscope. The ice was allowed to melt and the liquid was shaken to saturate the air in the bottle with the odor of the liquid.

By setting the instrument at its highest reading, a sniff through the nosepiece will draw in one volume of odor-laden air from the bottle and 63 volumes of fresh air. The odor will thus be diluted 1 to 64 or 2^{-6}. If the odor is not sensed in this dilution, its pO value (relative odor value, or intensity of odor) is less than pO 6. In this case the setting is changed to its next higher position, and so on until the point is reached where the odor is barely detectable, which reading is the relative odor value.

Thus a new and very practical use has been found for the osmoscope. Previously, it had been used to determine the odor value of water, but now it can be used to determine this value in air by first freezing out the water and odor in the air. After determining the relative odor value, the total amount of condensate was reserved for identification tests and quantitative determinations of the detectable odorous substances.

TABLE 1.—TESTS ON RECIRCULATED AIR

Relative odor value (of 200 cu. ft.)	40.
Ammonia (NH_3), p.p.m.	0.06
Nitrite (NO_2), p.p.m.	0.0008
Alcohol (C_2H_5OH), p.p.m.	0.3
Phenolic bodies, p.p.m.	0.006

With a practical method for determining the intensity of odor it is hardly necessary to attempt a thorough chemical analysis. The wide variety and structural complexity of substances which impart odor render direct quantitative determinations of little significance. In Table 1 only four substances were determined and these only because they could be detected and were known to exist. They serve only as a check on the relative odor value, for certainly their combined odor intensity is only a small percentage of the total.

The ammonia and nitrite present are apparently derived from one or both of two sources: the decomposition of other nitrogenous products, or the effects of oxidation and ultraviolet rays on the nicotine in tobacco smoke. The absence of nicotine and sulfur compounds may be accounted for by the ease with which they are oxidized in such thin films, or they may escape detection because of the minute degree of concentration. The alcohol is undoubtedly due to the consumption of alcoholic beverages by passengers. The phenolic bodies are apparently derived from the smoke of the locomotive. The condensate also had a distinct petroleum-like odor, which may be accounted for by the fact that the train passed through a district where large oil refineries were located, or it may have been due to lubricating oil on machinery in and about the car.

Heating a Sheep Barn

EARLY lambs, frequently called "hot house" lambs, are preferred by many Wisconsin sheep raisers because they are usually more profitable. Growing and marketing conditions favor early lambs.

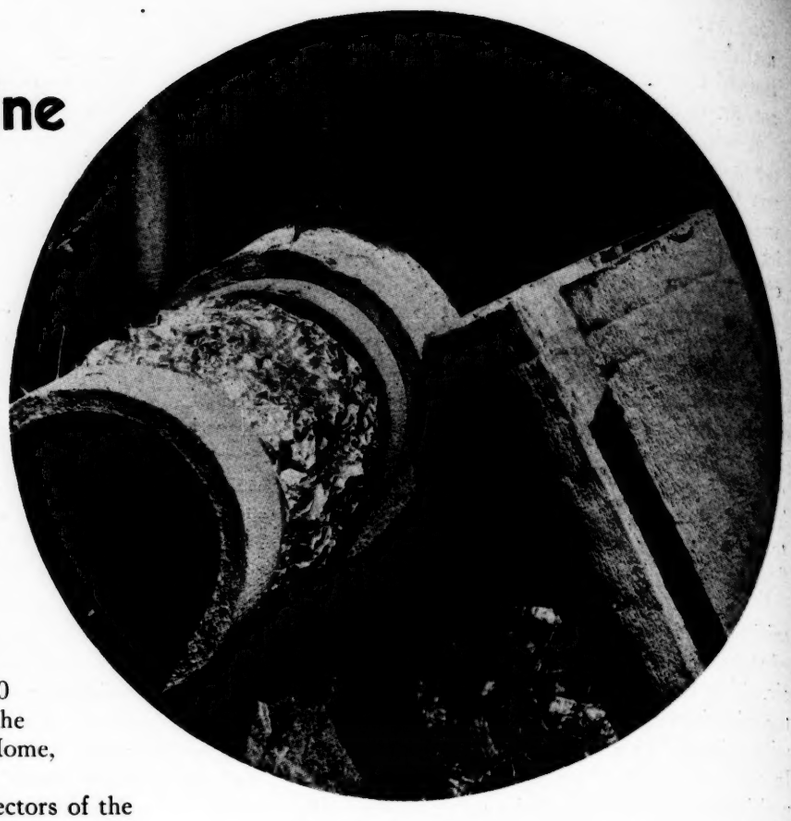
Early lambs usually do well under ordinary housing conditions in dry sheds, even in very cold weather if they are at least a week old before they are exposed to these rigorous housing conditions. For low mortality of early lambs a warm, dry lambing barn must be provided.

On a farm in south central Wisconsin, a sheep barn 30 ft. by 64 ft. was being used for lambing in February, 1935, when an urgent call for help was sent in to the University. Wall fans could not keep the barn dry without lowering the temperature too much, and lambs were being lost at an alarming rate. Some rapid heat loss and humidity calculations indicated that five 500-watt heating elements would supply enough heat to dry up the barn. A blower was set up and a metal tube 6 in. in diameter and some 5 ft. in length was installed on the discharge end of this fan. In this metal tube the heating elements were mounted, and this heater was set to work the same day the call for help was made. By morning the air had a much lower humidity and the barn was warm enough for the lambs. But few lambs were lost after the heater was installed.

Obviously, the cost of operating this heater was high, but it demonstrated the need for artificial heat to the owners. Plans were made and a haydite block furnace room was built outside and at the west end of the barn. A blower draws outside air over this furnace and forces it into the barn, thus tempering the incoming air for moisture and temperature control. A wall fan at the far end of the barn draws this tempered air the full length of the barn and discharges the air from the barn.

Not only is this barn a success as a lambing barn but also as a drying barn. In the fall of 1935, 900 bushels of corn were hung on binder-twine hangers from the hay-loft floor joists. The furnace and fans were used to dry what turned out to be a valuable crop of seed corn.—*From Winter Meeting of the American Society of Agricultural Engineers, 1936.*

District Steam Line Uses Aluminum Foil Insulation



THE largest application of aluminum foil insulation to piping ever made in the United States consists of the 300,000 sq. ft. of material which were used on the steam lines of the Allegheny County Home, Woodville, Pa.

The home, which is operated by the Directors of the Poor of Allegheny County for the care of the aged, the mentally ill, and tubercular patients, recently added nine units to its already extensive plan. The new buildings include the hospital unit, a male mental hospital addition, a nurses' dormitory, the tuberculosis hospital nurses' home, the farm colony, the laundry, an addition to the female mental hospital, an addition to the power plant, and staff residences—six of these considered as one unit.

To supply heat for the new buildings, the power plant had to be enlarged and steam lines had to be rerouted. About two miles of the lines are above ground, while thirteen miles of piping are located in tunnels and basements.

The piping insulated with aluminum foil included all high-pressure steam lines, all exhaust lines, all high-pressure drips, all heating supply mains and returns, all hot water circulating lines, and all cold water lines. Steam is carried in these lines year in and year out, for besides heating it is also used for sterilization and cooking purposes and must be available at all times. The foil wrapping is covered with asbestos and the type of outside covering best suited to the different conditions under which the piping is used.

Aluminum foil insulating material shown used in outside steam lines in service in severe weather. Icicles are suspended from waterproof paper, while a little more than an inch below flows high-pressure steam at 360F.

This novel combination of the newer aluminum foil insulation and the older, well-proven asbestos, takes advantage of the superior properties of each at a lower cost than if either type had been used by itself.

Aluminum foil insulation consists of very thin sheets of aluminum which have the ability to reflect the radiant heat falling upon them. The number of sheets employed depends upon the temperature of the liquid or steam carrier. The sheets are spaced close enough so that they prevent movement of the air between them.

Although aluminum foil has excellent insulating value, it has no structural strength and therefore must be protected from damage in some manner. For this reason the asbestos jacket is laid around the foil.

The light weight of aluminum foil offers considerable advantages as an insulating material for refrigerator cars and trucks, but this quality was not required at the Allegheny County Home. The insulating efficiency and the ease of application were the two advantages which decided its use.

The methods of application are many and varied. In some cases the layers of foil are spaced around the article to

be insulated by means of rigid material of low thermal conductivity. In others, the foil is crumpled loosely to produce random ridges and valleys in the sheet and in the successive layers wrapped around the article. By crumpling the foil, it provides its own spacing. In most applications one layer of crumpled foil is used for each 1/3 in. of space.

In the application at Allegheny County Home, rings of asbestos were placed at all terminals and bends and on 18-in. centers in the spans. The thickness of these rings was varied according to the need for insulation. For pressures less than 20 lb. steam, ½ in. by 3 in. rings were used, while on lines with pressures up to 150 lb., the ring dimensions were 1 in. by 4 in. Layers of crumpled aluminum foil were then wrapped around the pipe in the spaces between the rings, two layers of foil for low pressures, four for high pressures. Asbestos jackets were then placed over the aluminum foil, the ends of the jackets resting on the rings. Jackets ½-in. thick were used on the low-pressure lines, while on the high-pressure lines the thickness of the jackets was increased to an inch. Rings and jackets were bound with wire to hold them in place.

Over the asbestos jackets canvas cloth was sewn if the lines were inside. Waterproof paper was used on the outside lines. The canvas was painted; the waterproof paper was left unpainted. Largest piping used was 20 in., smallest was ½ in.

The entire project of construction and installation of mechanical equipment in the new units of the Allegheny County Home was made under the direction of the Allegheny County Directors of the Poor. The project is identified as PWA No. 4242 and included contracts to McGinness, Smith & McGinness, plumbing; George H. Soffel Company, heating; George V. Hamilton Company, insulating. All are Pittsburgh firms.

What Is Known About Silicosis

ON the basis of present knowledge, nine points are definitely known regarding silicosis. They are:

1. Silicosis results from the inhalation of dust containing free silica.
2. The time required for development of silicosis varies from a few years to 20 or more, depending on the concentration of silica particles in the air and the length of exposure.
3. Beginning silicosis is recognizable only by properly taken roentgen films (X-rays) of the chest.
4. Associated with silicosis is a marked predisposition to tuberculosis.
5. Silicosis can be prevented by protecting the industrial worker from inhaling silica dust.
6. Concentrations to which dust must be reduced in order to be safe have not been absolutely determined.
7. Industrial dusts, containing silica, are frequently not all silica, being mixed with other materials. Some of these substances may alter the silica action in the body.
8. Asbestos, a silicate, is the only dust other than free silica which has been shown to cause lung fibrosis and disability.
9. Simple—that is, uncomplicated—silicosis, as seen in industries in the United States, causes relatively little severe disability.

This list was taken from a report entitled "Silicosis and Allied Disorders" which was submitted to the Air Hygiene Foundation by its Medical Committee.

Precipitators Trap Pay Dirt

RECAPTURING four tons of china glaze a week (valued 6 cents to $2 a pound depending upon type) 10 newly-installed electrostatic dust precipitators applied to five automatic glazing machines in the Homer Laughlin China Co., Newell, W. Va., will soon pay for themselves out of savings. In addition, floor space and cleaning time are but one tenth that formerly required by the settling chambers, which the 98% efficient electrostatic units replaced.

With each automatic machine spouting 300 dishes a minute (8000 dozen daily) and spraying 8 gal. (116#) of liquid glaze mixture a minute, the huge settling chambers previously salvaged 1200 lb. per week of expensive ingredients from the excess spray; but cleaning was difficult, time consuming, and an unhealthful task. The present electrostatic glaze-saver snares particles as small as one micron in size, collects an additional 400 lb. of glaze per week (1600 lb. total), makes available 300 sq. ft. of additional floor space per machine, and deposited material is collected by merely hosing-out the ionizing chamber with water.

New in principle and developed by Westinghouse Electric & Mfg. Company, and installed by Pangborn Corporation, each of these 2400 c.f.m., self-contained electronic precipitators first ionizes incoming particles with 15,000 volts d.c. and, subsequently, attracts the charged particles to deposit plates by a 7500 volt d.c. electrostatic field in the collector assembly. Operation cost is negligible, each unit when operating at full capacity consuming but 75 watts.

Two of the 10 electrical precipitators which are recovering four tons of china glaze weekly

How to Design a Mechanical Warm-Air System

The Standard Code for gravity warm-air heating systems, first issued fifteen years ago, reduced the calculations involved in designing such plants to a simple routine. The National Warm Air Heating and Air Conditioning Association, which introduced the Standard Code, now presents its Technical Code for the Design and Installation of Mechanical Warm Air Heating Systems, reprinted here. This outstanding code simplifies the design of forced systems as did the Standard Code that of gravity plants.

THE growing popularity of mechanical warm-air heating systems for residences was responsible for the sponsoring of a non-technical code covering these systems by the National Warm Air Heating and Air Conditioning Association in 1933. Since that time there has been an increasing demand for a *technical* code covering mechanical warm-air plants, and this demand has finally been met by the Association in its latest code, formally known as the "Technical Code for the Design and Installation of Mechanical Warm-Air Heating Systems—First Edition, February, 1937."

In view of the desirability of the widespread adoption of a simple and convenient method of calculating these systems—a requirement which this code seems to meet—the code is reprinted here. It has not been reprinted in full, since much of the material in the code is already standard practice, but all of the essential information appears here, in some cases slightly rearranged or paraphrased.

Intent of the Code—This Code is formulated to provide reliable methods of design and installation of mechanical warm-air heating systems for the protection of the buying public. It covers fundamental data and rules which of necessity must be observed. In all cases, however, *experience* is necessary to obtain the full value of its application. *This Code does not attempt to provide the application of all variables found in practice.*

Article 1—Scope of Code

This Code applies to systems with capacities of not over 250,000 B.t.u. per hr. at the registers, with air volumes not exceeding 5500 c.f.m., for buildings not over three stories high, with inside air temperatures not less than 70F, and with register air temperatures between 110 and 150F. For larger or unusual systems, the Code advises consultation with recognized engineering authorities.

Article 2—Definitions

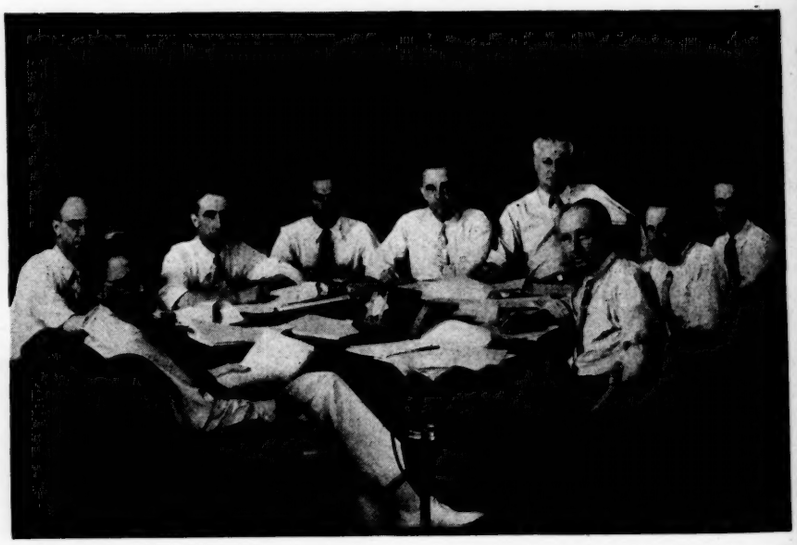
Section 1—Mechanical warm-air heating systems, to which this code refers, shall consist of one or more warm-air heating units within individual housings or within one common housing, one or more motor-driven blowers, smoke or vent pipes, individual leader pipes or trunk line systems, or both, with necessary control dampers for supply and return air, automatic controls, registers, faces and grilles; and with provision for other appurtenances such as filters, air washers, ozonators, humidifiers, etc., as may be desired.

Section 2—An individual supply system shall consist of separate ducts of round or rectangular cross sections, without branches, and extending from the heating unit. Return ducts may be individual or trunk lines or a combination of both.

Section 3—A trunk line system consists of one or more main ducts with branches.

Article 3—Estimating Heat Loss

Section 1—This is done by finding the heat loss, H, in B.t.u. per hour, from each room and then combining all the heat losses for the several rooms into one heat loss, H_b, for the building. The values of H are to be used in estimating the sizes and capacities of the *registers, grilles, stacks,* and *supply* and *return ducts* for the respective rooms; and the value H_b is to be used in esti-



Members of the Installation Codes Committee of the N.W.A.H. & A.C. Association which formulated the code presented here. Left to right, around the table: B. F. McLouth, Dail Steel Products Co.; Prof. A. P. Kratz, University of Illinois; Fred R. Bishop, Brundage Co. and American Air Filter Co.; Jack Stowell, Robinson Furnace Co.; W. D. Redrup, Majestic Furnace Co., J. E. Maynard, Fox Furnace Co.; L. N. Smoot, Holland Furnace Co.; E. B. Langenberg, Langenberg Heating Co.; Prof. J. D. Hoffman, Purdue University, chairman of the committee. Not shown are J. F. Firestone, G. A. Voorhees, S. Konzo, W. E. Nesbit, and C. M. Lyman. Mr. Lyman, a member of various committees of the Association for 25 years, died suddenly February 28.

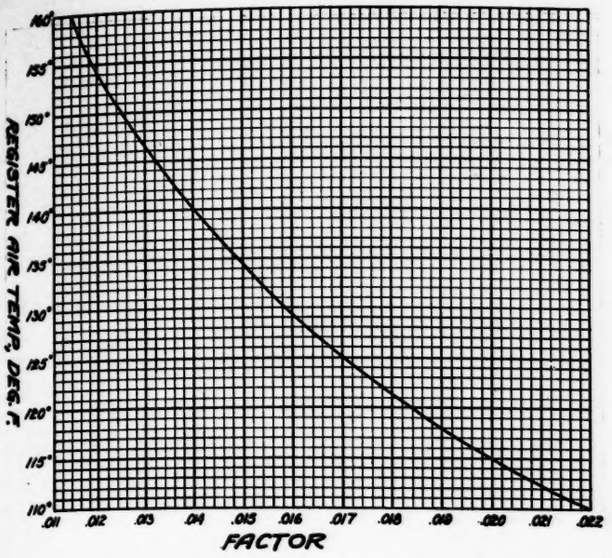


Fig. 1. Multiplying factor for use with heat loss of building to determine c.f.m. requirements

mating the sizes and capacities of the various parts of the combined heating system for the building, composed of *furnaces, blowers, washers, filters,* and related equipment.

In estimating the heat losses for the various rooms, several items necessarily combine to form the value H; i.e., losses by transmission through (1) exposed glass, (2) exposed wall (including basement wall above grade), (3) partition wall to adjoining rooms of lower temperatures, (4) ceilings to attic space, (5) ceilings, part of roof, no attic space, (6) floors to unexcavated or cold spaces below, (7) basement walls below grade to surrounding ground, (8) basement floors to the supporting ground underneath, and (9) by infiltration. These the Code recommends be the standard heat loss method. The Code includes formulas for this method, together with tables of heat conductivities and transmission coefficients for various types of construction which, since they are in common use, need not be reproduced here. Similarly, a table of outside design temperatures is given in the Code. Since this table appeared in HEATING & VENTILATING (July, 1936) it will not be shown here.

Article 4 – Selection of the Furnace

Section 1—The furnace shall be selected to satisfy the B.t.u. requirement, H_h, of the building. The furnace used for burning *solid fuels* shall be rated according to the following equation:

$$\textit{B.t.u. available per hour at register} = 0.85\,(G \times E \times F \times C)\,[1 + 0.02\,(R - 20)] \quad \ldots\ldots (1)$$

Where

G = grate area in square feet; E = efficiency of the furnace at the bonnet, (0.65); F = calorific value of the fuel (unless otherwise specified, manufacturers generally use 12,000 B.t.u. for catalog ratings); C = combustion rate; i.e., pounds of fuel burned per hour per square foot of grate (7.5), with a minimum draft at the smoke pipe connection to the furnace of not less than 0.12 in. of water; and R = ratio of heating surface area to grate area.

For furnaces designed to burn *fuel oil or gas,* use manufacturers' ratings. In no case shall the input exceed the furnace manufacturers' specifications. It is not advisable to use more than 75% bonnet efficiency in sizing equipment.

When furnaces are *stoker fired,* use a combustion rate of not to exceed 10 lb. per sq. ft. of equivalent grate area per hour for normal operation, and 65% efficiency at the bonnet for 12,000 B.t.u. coal.

For highest efficiencies, when using blowers, baffling is recommended.

Article 5 – Design Register Air Temperatures

Section 1—To find the total c.f.m. for the rooms to be heated multiply the total cubic contents of rooms by the number of air changes selected and divide by 60. The total building c.f.m. *requirements* shall be equal to, or greater than, five complete air changes through the system per hour, dependent upon the resultant register air temperature. (See Section 2.) To determine the average register temperature, divide the total building c.f.m. by H_b for c.f.m. factor and refer to Fig. 1. Systems installed in old houses utilizing old stacks are exceptions.

Section 2—Fig. 1 is charted by use of the following equation:

$$\textit{C.f.m. at register} = \left(\frac{1}{0.24d \times (t - t') \times 60}\right) \times H \quad \ldots\ldots (2)$$

Where

H = B.t.u. heat loss of room; d = density or weight of entering air at register in pounds per cubic foot; t = temperature of entering air (register temperature); t' = temperature of air leaving room (return air temperature); 0.24 = specific heat of air, or B.t.u. required to raise 1 lb. of dry air 1F; 60 = min. per hr.

For the usual range of entering air temperatures the terms written in the bracket in equation (2) may be reduced to a single factor and the equation may be written:

$$\textit{C.f.m.} = \textit{Factor} \times H \quad \ldots\ldots (3)$$

These factors, corresponding to the various register air temperatures and based on 65F return air temperature, as given in Fig. 1, offer a simple and reliable method for obtaining the c.f.m. for each room.

Example—Suppose the register air temperature is 135F, then from Fig. 1 the factor is 0.0149. If the heat loss, H, is 15,000 B.t.u. per hr., then the volume of air flowing to the room in c.f.m. $= 0.0149 \times 15{,}000 =$ 224.

It is common practice to proportion the return ducts upon the same volume basis as the supply ducts.

Section 3—C.f.m. Requirement per Room: Due to the fact that the drop in temperature between the bonnet and the register is dependent upon the actual length of the run, it is necessary to compute the bonnet temperature and establish the register temperature for each run. Multiply the B.t.u. load of each run by the factor corresponding to the register temperature, as shown in Fig. 1.

Article 6 – Duct Design Procedure

Section 1—Outline: (a) Make a line diagram of tentative layout. See Fig. 2; (b) measure the actual length of each run from register to furnace; (c) compute the equivalent length of each turn in each run from register to furnace and add the same to the actual

length of the respective runs. These results are the total equivalent lengths; (d) compute the bonnet air temperature; (e) compute the register temperature of each run; (f) compute the c.f.m. for each register based on warm-air temperature at each register; (g) select the run having the greatest friction loss and base the design on this resistance; (h) determine round pipe size for each run; (i) correct pipe diameter of each run for various equivalent lengths; (j) compute rectangular equivalents for stack and branch sizes; (k) determine trunk sizes in round pipe diameters; (l) correct round pipe diameters for each trunk; (m) obtain rectangular equivalents of trunk sizes; (n) follow same procedure for the design of the return side of the system as is used for the warm-air side; (o) compute total resistance of the system; (p) select blower to supply the total c.f.m. at a static pressure equal to or greater than the total resistance of the system, and select motor to suit blower; (q) select filters, washers, and other appurtenances; (r) select registers and grilles; (s) select controls.

Section 2—Explanatory Notes relating to Section 1:

Item (a) A general knowledge of building construction is necessary to aid in an intelligent and practical heating layout. If a room requires more than 150 c.f.m., it is best to use two or more supply openings to bring about better room circulation. It is advisable to oversize recreation room supply to counteract radiant loss to bare basement walls and pickup load due to intermittent heating. This may be done by using a design room temperature from 5 to 10 degrees above that for living rooms.

It is advisable, when possible, to install a separate run direct from heater unit to garage, should same be heated. It is also advisable to exercise extra care in sizing supply and return lines to rooms over garages. Return air shall be brought back from as many rooms as possible excepting from bathrooms and garages. Care should be taken to draw from each room or series of intercommunicating rooms air equivalent to the amount designed to be delivered to the room or series of rooms; also that the *total* air to be returned shall in no case be less than the *total* equivalent supply of warm air to all rooms, unless compensated for by the admission of outside air.

It is suggested that equivalent air be introduced into the system from the outside to compensate for that vented from garages. A little outside air (approximately 5% by volume) is a good practice on all jobs.

Item (b) Actual Length: The actual length of a rectangular or round warm air or return air run is the lineal feet of pipe or duct between the register and the furnace.

Example 1. See Diagrams A and B, Fig. 2: Add lineal feet of stack from the register box along the line E, D, A, W, X, Y, Z, to furnace, equalling 42 ft., which is the actual length of that run.

Item (c) Equivalent Length: The equivalent length of a round or rectangular run is the total actual length, plus the equivalent lengths in straight pipe or duct, of all turns. Assume all 90° turns equal to 10 ft. of straight pipe or duct, and 45° turns and register boxes equal to 5 ft. of straight pipe or duct.

Example 2. See Diagrams A and B: Add equivalent

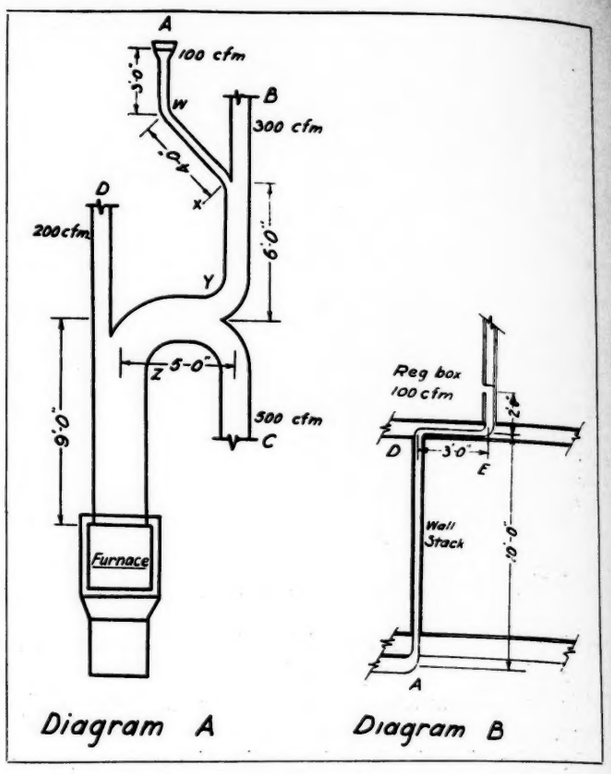


Fig. 2. Sketches for layout of system used to illustrate working of code

length of register box to turns at E, D, A, W, X, Y, Z, and at furnace, equalling 75 ft. Add to this the actual length of the run, 75 ft. + 42 ft. = 117 ft. = total equivalent length of the run.

Item (d) To determine bonnet temperatures: In order to compensate for temperature drops between furnace and registers, it is necessary to compute the temperature of air at each register. From data collected in the field, it is safe to assume a temperature drop of ¼ of 1F per ft. under ordinary conditions. In Art. 5, Sec. 1, an average register temperature was arrived at by dividing the total building c.f.m. by H_b and referring to Fig. 1. This average register temperature represents the design temperature of a register located at a point one-half the actual length of the longest run.

Example 3. If the actual length of the longest run is 60 ft. the average register temperature is the design temperature of a register 30 ft. from the furnace.

Example 4. If the longest run is 150 ft., the average register temperature is the design temperature at 75 ft.

Inasmuch as there is an assumed temperature drop of ¼ of 1F per ft., the bonnet temperature is the average temperature plus ¼ times ½ the lineal feet of the longest run.

Example 5. Referring to Example 3 where the longest run was 60 lin. ft., the bonnet temperature would be the design temperature $+ \left(\frac{1}{4} \times \frac{60}{2}\right)$. Assuming an average design temperature of 135F, the bonnet temperature would be $135 + \left(\frac{1}{4} \times \frac{60}{2}\right) = 135 + 7.5 = 142.5$F.

TABLE 6.†—SIZE OF ROUND PIPE REQUIRED FOR VARIOUS C.F.M. CAPACITIES AND STATIC PRESSURE LOSSES

(*Denotes commercial pipe size)

Design Static Pressure, In. of Water					Dia., In.	Design Static Pressure, In. of Water					Dia., In.
0.06	0.08	0.10	0.12	0.15		0.06	0.08	0.10	0.12	0.15	
Volume, Cubic Feet per Minute						Volume, Cubic Feet per Minute					
45	50	55	65	70	5.0*	460	535	600	650	750	12.0*
47	55	60	67	75	5.1	470	550	615	670	770	12.1
50	57	65	70	80	5.2	480	560	630	685	785	12.2
53	60	67	75	85	5.3	495	575	640	705	805	12.3
55	62	70	77	90	5.4	505	585	655	720	820	12.4
57	65	75	80	95	5.5	515	600	670	740	840	12.5
60	70	80	85	97	5.6	525	610	685	755	860	12.6
62	75	82	90	100	5.7	535	625	700	770	880	12.7
65	77	85	95	105	5.8	550	635	720	790	900	12.8
70	80	90	100	110	5.9	560	650	735	805	920	12.9
73	82	95	102	120	6.0*	570	660	750	820	940	13.0
75	85	100	105	125	6.1	580	675	765	835	960	13.1
78	90	102	110	130	6.2	595	690	780	850	975	13.2
80	95	105	115	135	6.3	605	710	800	870	995	13.3
85	100	110	120	140	6.4	620	725	815	885	1010	13.4
90	105	115	125	145	6.5	630	740	830	900	1030	13.5
92	110	120	130	150	6.6	645	755	850	920	1050	13.6
95	112	125	135	160	6.7	660	770	865	935	1075	13.7
100	115	130	145	165	6.8	670	780	885	955	1095	13.8
105	120	135	150	170	6.9	685	795	900	970	1120	13.9
110	125	140	155	175	7.0*	700	810	920	990	1140	14.0*
112	130	150	160	185	7.1	714	825	935	1010	1160	14.1
115	135	155	170	190	7.2	730	840	950	1030	1180	14.2
120	140	160	175	200	7.3	740	860	970	1050	1200	14.3
125	145	165	180	205	7.4	760	875	985	1070	1220	14.4
130	150	170	185	215	7.5	770	890	1000	1090	1240	14.5
135	155	175	190	220	7.6	785	905	1020	1110	1265	14.6
140	160	180	195	230	7.7	800	920	1040	1135	1290	14.7
145	165	190	205	235	7.8	810	940	1060	1155	1310	14.8
150	170	195	210	245	7.9	825	955	1080	1180	1335	14.9
155	180	205	220	255	8.0*	840	970	1100	1200	1360	15.0
160	185	210	230	265	8.1	880	1010	1150	1250	1430	15.25
165	190	215	235	270	8.2	920	1055	1200	1300	1500	15.5
170	195	220	240	280	8.3	960	1090	1250	1360	1570	15.75
175	200	230	250	290	8.4	1000	1140	1310	1420	1640	16.0*
180	210	240	260	300	8.5	1040	1190	1370	1480	1710	16.25
190	220	250	270	310	8.6	1080	1245	1430	1540	1780	16.5
195	225	255	280	320	8.7	1125	1300	1490	1600	1850	16.75
200	230	260	285	330	8.8	1170	1355	1550	1670	1920	17.0
210	240	270	290	340	8.9	1220	1410	1610	1740	1995	17.25
215	250	280	305	350	9.0*	1270	1465	1670	1820	2070	17.5
220	255	285	310	360	9.1	1320	1525	1740	1900	2150	17.75
225	260	295	320	370	9.2	1370	1585	1810	1980	2230	18.0*
230	265	300	330	380	9.3	1420	1645	1880	2060	2315	18.25
240	275	310	340	390	9.4	1480	1705	1950	2140	2400	18.5
245	280	320	350	400	9.5	1540	1765	2020	2220	2500	18.75
250	290	330	360	415	9.6	1600	1830	2090	2300	2600	19.0
260	300	340	370	430	9.7	1660	1900	2160	2380	2700	19.25
270	310	350	380	440	9.8	1720	1970	2240	2460	2800	19.5
275	320	360	390	450	9.9	1780	2040	2320	2550	2900	19.75
280	325	370	400	460	10.0*	1850	2120	2410	2650	3000	20.0*
290	335	380	410	475	10.1	1930	2210	2520	2800	3200	20.5
395	345	390	420	485	10.2	2020	2420	2650	2960	3400	21.0
305	350	400	435	500	10.3	2120	2540	2800	3130	3620	21.5
310	360	410	445	510	10.4	2230	2680	2960	3310	3840	22.0*
320	370	420	455	525	10.5	2350	2840	3130	3500	4100	22.5
330	380	430	470	540	10.6	2490	3010	3310	3700	4330	23.0
335	390	445	480	555	10.7	2640	3190	3500	3920	4600	23.5
345	400	455	495	570	10.8	2800	3380	3700	4160	4880	24.0*
350	410	470	505	585	10.9	2970	3580	3920	4420	5200	24.5
360	420	480	520	600	11.0	3150	3790	4160	4710	5420	25.0
370	430	490	530	615	11.1	3340	4010	4420	5030	—	25.5
380	440	500	545	630	11.2	3540	4240	4710	5380	—	26.0*
390	450	515	555	640	11.3	3750	4480	5030	—	—	26.5
400	460	525	570	655	11.4	3970	4730	5390	—	—	27.0
410	470	535	580	670	11.5	4200	4990	—	—	—	27.5
420	485	550	595	685	11.6	4440	5270	—	—	—	28.0*
430	495	560	610	700	11.7	4690	5580	—	—	—	28.5
440	510	575	620	720	11.8	4950	—	—	—	—	29.0
450	520	585	635	735	11.9	5500	—	—	—	—	30.0*

†Note: Tables 1 to 5, incl., of the code relate to calculation of heat losses and are not reprinted here. The table numbers of remaining tables have not been changed, to avoid confusion.

Item (e) Having determined bonnet temperature, the correct air temperature at any register may be computed by deducting from the bonnet temperature ¼ of 1F for each lineal foot between the bonnet and that register.

Example 6. Where the bonnet temperature is 142.5F

and the register is 40 ft. from the bonnet, the register temperature is 142.5F — (¼ × 40) = 142.5F — 10 = 132.5F.

By the above method, compute the correct temperature at each register.

Item (f) In order to compute the correct *c.f.m.* on each run, multiply the B.t.u. load of each run, by the factor obtained from Fig. 1 corresponding to the correct register temperature.

Example 7. Example 6 shows the air temperature of a certain register to be 132.5F. From Fig. 1 find the c.f.m. factor corresponding to 132.5F to be 0.0154. If *H*, the number of B.t.u. to be delivered by that register were found to be 6500; 6500 × 0.0154 = 100.1 c.f.m. In like manner find c.f.m. of any warm-air run.

Item (g) Selection of Design Friction Loss. The *total* resistance to flow of air through ducts is due to two types of losses—friction and dynamic. This is equivalent to the friction losses in all straight runs plus the dynamic losses in all elbows and turns expressed in terms of friction losses in equivalent length of straight duct.

The *commonly accepted friction chart* is shown in Fig. 3. In the use of this chart a fair recommendation would be to design the average systems, where the capacities of the trunk having the longest equivalent run requires as much as 1600 c.f.m. on a resistance of 0.06 in.; from 1600 to 2400 c.f.m. on 0.08; from 2400 to 3600 c.f.m. on 0.10; and from 3600 to 5500 c.f.m. on 0.12 in. of water per 100 ft. of equivalent length. Where limitations of pipe size of any stack prevent the use of these recommendations, the design static pressure may be arrived at in the following manner:

By observation select the run having the greatest resistance and find its total *equivalent* length. To determine this resistance, from Fig. 3, find the resistance in inches of water per 100 ft. necessary to handle the required c.f.m. through this duct of available size. Multiply this resistance per 100 ft. by the total equivalent length and divide by 100. The result is the design static pressure of this run, as well as the design static pressure of the entire system provided it is within practical limits.

Items (h) and (i) For individual round pipes refer to Table 6 for diameter required to handle a given c.f.m. at the design static pressure. Correct for pressure differences due to unequal equivalent lengths by multiplying the diameter of the pipe by the correction factor corresponding to the total equivalent length from bonnet to register, as shown in Table 9.

Example 8. The run in Example 7 was found to require a capacity of 100 c.f.m. If the design static pressure were chosen at 0.06, the pipe diameter from Table 6 is found to be 6.8 in. If the register were found to have an equivalent length of 80 ft. from the furnace, the correct diameter can be found by multiplying 6.8 by the correction factor corresponding to 80 ft. from Table 9. 6.8 × 0.965 = 6.56, or say, 6.6 in. in diameter. This method will size and correct all warm-air runs giving proper pipe diameters of runs up to 200 ft. of equivalent length.

Item (j) Sizing wall stacks and branches: See Tables 7 and 8.

Example 9. Example 8 gave a pipe diameter of 6.6 to deliver 100 c.f.m., 80 ft. of equivalent length from the furnace and at a static of 0.06. From Table 7 find that a 10 × 4, an 11 × 3½ or a 13 × 3 stack will be satisfactory. The nearest commercial stack size in this case is a 12 × 3½. In like manner and by the use of Table 8, a 6 × 7, 5 × 8, 5 × 9 or 4 × 10 rectangular duct will satisfy the above conditions.

Item (k) Sizing trunk lines, in round pipe diameters:

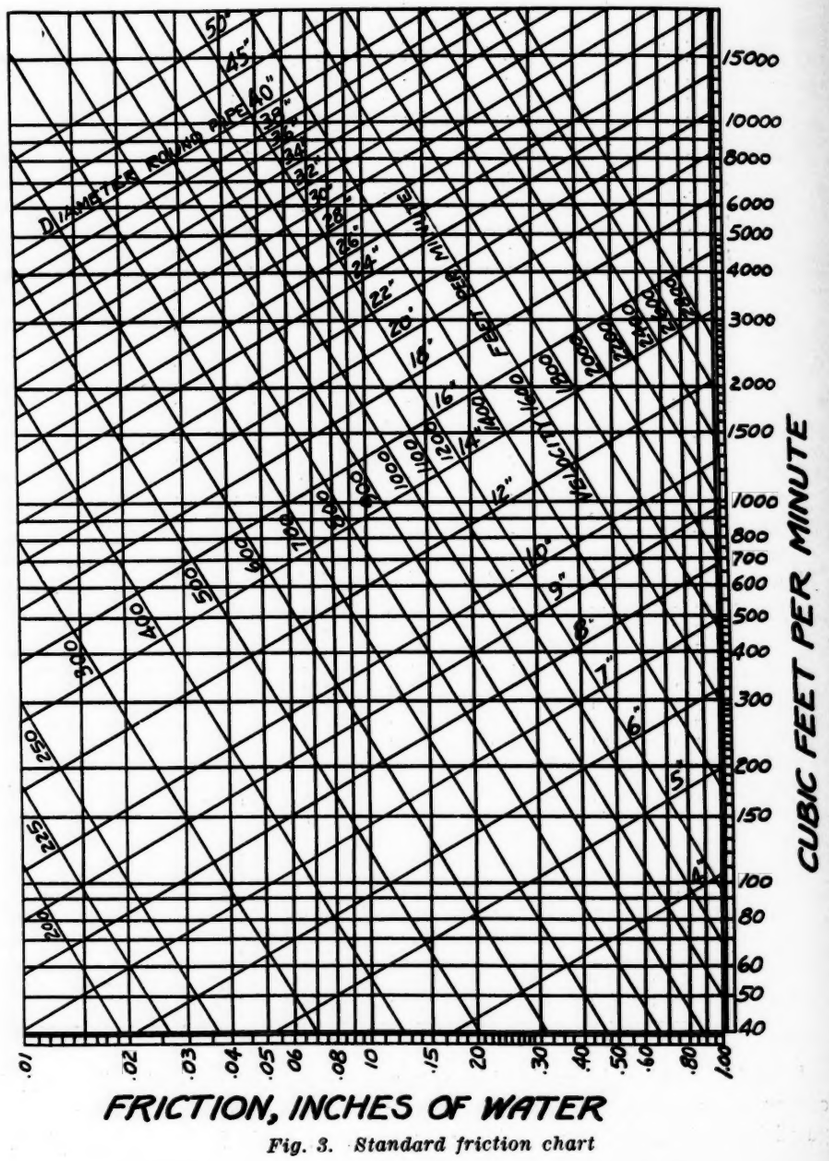


Fig. 3. Standard friction chart

TABLE 7.—CONVERSION TABLE FOR DETERMINING WALL STACK SIZES EQUIVALENT TO GIVEN ROUND PIPE SIZES

*Denotes commercial stack size.

Round Pipe Dia., In.	Wall Stack Size, In.	Round Pipe Dia., In.	Wall Stack Size, In.	Round Pipe Dia., In.	Wall Stack Size, In.	Round Pipe Dia., In.	Wall Stack Size, In.	Round Pipe Dia., In.	Wall Stack Size, In.
5.2	8 x 3	8.1	10 x 5½	7.4	12 x 4	9.2	13 x 5½	8.2	15 x 4
5.7	8 x 3½	6.0	11 x 3	7.9	12 x 4½	6.7	*14 x 3	8.7	15 x 4½
5.5	*9 x 3	6.6	11 x 3½	8.3	12 x 5	7.4	*14 x 3½	9.2	15 x 5
6.0	9 x 3½	7.1	11 x 4	8.8	12 x 5½	7.9	14 x 4	9.8	15 x 5½
5.8	*10 x 3	7.6	11 x 4½	6.5	13 x 3	8.5	14 x 4½	7.1	16 x 3
6.3	*10 x 3½	8.0	11 x 5	7.1	13 x 3½	8.9	14 x 5	7.8	16 x 3½
6.8	10 x 4	8.5	11 x 5½	7.7	13 x 4	9.5	14 x 5½	8.4	16 x 4
7.2	10 x 4½	6.3	*12 x 3	8.2	13 x 4½	6.9	15 x 3	9.0	16 x 4½
7.7	10 x 5	6.9	*12 x 3½	8.7	13 x 5	7.6	15 x 3½	10.1	16 x 5½

Starting at the extreme end of the trunk line and working toward the heater unit, add the c.f.m. of the first two or more branches joining at that point. Find the diameter of the trunk for that point from Table 6 using the desired design static pressure. To the c.f.m. at this point add the c.f.m. of the next branch joining the trunk and find the diameter of the trunk at this new location. In like manner add the c.f.m. of each succeeding branch to the c.f.m. of the duct at point of juncture.

Example 10. Analysis of one complete run: Referring to Diagrams A and B, Fig. 2, and Example 2, assume the run A to be the end run of the trunk line. This run must handle 100 c.f.m. and its equivalent length is 117 (use 120) ft. Assuming a design static of 0.06 the round pipe diameter is 6.8, see Table 6. From Table 9 (correction table) 6.8 × 1.035 = 7.038 (say 7.1) in., the corrected round pipe diameter of the branch.

Adding the 300 c.f.m. of the first branch (B) to join the 100 c.f.m. of the branch A find a total of 400 c.f.m. From Table 6, 400 c.f.m. at 0.06 static pressure gives a pipe 11.4 in. in diameter. 11.4 × 1.035 = 11.799 (sav 11.8) in., the corrected pipe diameter. Adding the 500 c.f.m. of C to the 400 c.f.m. of A and B there is 900 c.f.m. 900 c.f.m. at 0.06 static pressure gives a pipe 15.5 in. in diameter. 15.5 × 1.035 = 16.04 (say 16.0), the corrected pipe diameter. In like manner 200 c.f.m. at D plus 900 c.f.m. of A + B + C = 1100 c.f.m. 1100 c.f.m. at 0.06 static pressure = 16.75. 16.75 × 1.035 = 17.35 (say 17.4), the diameter of trunk line at furnace.

Item (l) In order to correct the trunk line to bring about the design static pressure regardless of its length, it is necessary to multiply the diameter of the trunk between branches by a common correction factor. This factor is the same factor used in correcting the diameter of the branch with the greatest equivalent length, regardless of the point of intersection with this trunk. Should two trunk lines merge, treat each as individual trunks to point of intersection. Total the c.f.m. of each trunk at this point and proceed as one trunk. If there are two or more trunk lines to the furnace, design and correct each trunk as outlined above.

Item (m) Refer to Table 8 for rectangular equivalents.

Item (n) Size return air trunks and branches, or individual ducts or pipes in the same manner as on the warm-air side of the system.

Item (o) Total resistance of entire system: To find the total resistance of the entire system, it is necessary to add together the resistances offered by every portion

TABLE 8.—CONVERSION TABLE FOR OBTAINING EQUIVALENT SIZES OF RECTANGULAR AND ROUND DUCTS

Depth of Rectangular Duct, Inches					Width of Rectangular Duct, In.	Depth of Rectangular Duct, Inches					Width of Rectangular Duct, In.
7	8	9	10	12		7	8	9	10	12	
Round Pipe Diameter, Inches						Round Pipe Diameter, Inches					
5.0	5.2	5.5	5.8	6.3	3	14.3	15.4	16.4	17.3	19.2	26
5.8	6.1	6.5	6.8	7.4	4	14.5	15.6	16.7	17.6	19.5	27
6.5	6.9	7.3	7.7	8.3	5	14.8	15.9	17.0	18.0	19.8	28
7.2	7.6	8.0	8.4	9.2	6	—	16.1	17.2	18.2	20.2	29
7.7	8.2	8.7	9.2	10.0	7	—	16.4	17.5	18.5	20.5	30
8.2	8.8	9.3	9.8	10.7	8	—	16.6	17.7	18.8	20.8	31
8.7	9.3	9.9	10.4	11.4	9	—	16.9	18.0	19.1	21.1	32
9.2	9.8	10.4	11.0	12.0	10	—	—	18.2	19.3	21.4	33
9.6	10.2	10.9	11.5	12.6	11	—	—	18.5	19.6	21.6	34
10.0	10.7	11.4	12.0	13.2	12	—	—	18.7	19.8	21.9	35
10.4	11.1	11.8	12.5	13.7	13	—	—	19.0	20.1	22.2	36
10.8	11.5	12.3	12.9	14.3	14	—	—	—	20.3	22.5	37
11.1	11.9	12.7	13.4	14.7	15	—	—	—	20.6	22.8	38
11.4	12.3	13.1	13.8	15.2	16	—	—	—	20.8	23.0	39
11.8	12.6	13.5	14.2	15.7	17	—	—	—	21.1	23.3	40
12.1	13.0	13.8	14.6	16.1	18	—	—	—	—	23.5	41
12.4	13.3	14.2	15.0	16.5	19	—	—	—	—	23.8	42
12.7	13.6	14.5	15.4	17.0	20	—	—	—	—	24.0	43
12.9	13.9	14.9	15.7	17.4	21	—	—	—	—	24.3	44
13.2	14.2	15.2	16.1	17.8	22	—	—	—	—	24.5	45
13.5	14.5	15.5	16.4	18.1	23	—	—	—	—	24.8	46
13.8	14.8	15.8	16.8	18.5	24	—	—	—	—	25.0	47
14.0	15.1	16.1	17.0	18.8	25	—	—	—	—	25.2	48

TABLE 9.—CORRECTION TABLES FOR PIPES OF UNEQUAL EQUIVALENT LENGTHS

Equivalent Length of Round Pipe in Feet	Correction Factor
200	1.150
190	1.140
180	1.125
170	1.115
160	1.090
150	1.075
140	1.065
130	1.050
120	1.035
110	1.020
100	1.000
90	.985
80	.965
70	.93
60	.905
50	.87
40	.835
30	.785
20	.725
10	.63

This table is for correcting the diameter of round pipes of unequal equivalent lengths, in order that any or all pipes, regardless of their equivalent lengths, will handle any required c.f.m. at the same predetermined static pressure.

of the entire system. As the warm-air and return air sides of the system are designed on a definite static pressure, and all runs corrected to offer this same static pressure, it is apparent that the design static of the circulating system is the sum of the two. The *total* resistance against which the fan must operate is, therefore, the resistance of the circulating system, plus the resistance of that register on warm air and return having the greatest resistance, plus the resistances of the heater, filter (usually 0.05), washers, cooling coils, eliminators, and other appurtenances.

Example 11. Assuming the design static pressure of each system (warm air and return) to be 0.08, add the following: 0.08 (warm air side) + 0.08 (return air side) + 0.03 (assumed static of register offering greatest resistance on warm-air side) + 0.02 (assumed resistance of register offering greatest resistance on return air side) + 0.05 (resistance of furnace) + 0.10 (resistance of filters, partially dirty) = 0.36 static resistance against which the blower must operate.

Item (p) Selection of Blowers: The blower capacity at 65F return air should be the equivalent of, or greater than, the sum of the c.f.m. required to supply all the outlets at the design warm-air temperatures, and at the total pressure of the entire system. It is assumed that all blower ratings are in accordance with the ASHVE Standard Test Code.

Item (q) Filters, Washers, and Cooling Coils: It is recommended that all furnaces be provided with some method of cleaning the air. In the case of filters it is recommended that the maximum velocity through the filters should not exceed 200 f.p.m. Use manufacturer's ratings for resistances and efficiencies. Generous filter areas are advisable to counteract reduced capacities and increased resistances when dirty. When washers are used, use manufacturer's ratings as to capacities and resistances. When cooling coils are used, use manufacturer's recommendations as to velocities through coils and their ratings for resistance.

Item (r) Registers and Grilles: Use registers and grilles of proper size and area. Same to be full width of stack. Use manufacturer's ratings for volume, velocities, and areas as required. When warm-air registers are placed in the baseboard, or just above the baseboard, they shall be sized on a basis of not more than 300 ft. average velocity. Downward deflecting registers permit velocities up to 500 f.p.m. When registers are placed above the breathing line (register top 18 in. below ceiling), they shall be sized on a basis of 500 ft. minimum velocity, excepting in bathrooms and toilets. Such registers must be horizontal or slightly downward direction of flow. Where the distance from the register to the opposite side of the room is over 15 ft., higher velocity should be used.

All baseboard or wall warm-air registers, either high or low, shall be properly sealed to the stack head or register box in such a manner as to prevent any leakage of air between the head and the register. Back pressure louver type registers must be used in garages. The resistance through registers varies with design and velocity. Consult manufacturer's catalog for data. All return air registers *should* be at the floor line.

Article 7 – Controls

Section 1—Blower Controls. An adjustable automatic furnace switch shall be placed in the bonnet of the furnace to start and stop the blower at predetermined temperatures. Under average conditions it should be set to start the blower at from 130 to 175F, and to stop the blower at from 100 to 130F. This setting should be determined by the register temperature at which the plant is designed to operate.

Section 2—Summer Switch. Unless automatically

TABLE 10—EQUIVALENT LENGTHS OF ROUND AND RECTANGULAR ELBOWS, ANGLES, AND OTHER TURNS.

To convert the dynamic loss in a *round elbow* to an *equivalent* length of pipe in feet, multiply diameter of elbow in inches by *number* of *diameters* offering equal *resistance* from Table 10a and divide by 12 in. Add equivalent lengths of all elbows and turns to the *actual* length of straight pipe in feet to obtain the total equivalent length from the *furnace* to the register.

TABLE 10a

Radius of inside throat in per cent of pipe diameter	0	¼	½	¾	1	1¼	1½
Diameters of round pipe offering equal resistance	38	18.5	13	10	8.5	8	7.5

To convert the dynamic loss in a *rectangular* elbow to *equivalent length of duct in feet,* multiply *width of elbow* in inches on the side making the turn by number of widths offering equal resistance (see Table 10b), and divide by 12 inches. Add equivalent lengths of all elbows and turns to actual length of straight pipe in feet to obtain the *total equivalent length* from *furnace* to register.

TABLE 10b

Radius of inside throat in per cent of pipe width	0	¼	½	¾	1	1¼	1½
Widths of rectangular pipe offering equal resistance	47.5	16.5	9	6	5	4.5	4

45° angles offer approximately half the resistance of 90 degree elbows. Side wall and baseboard register boxes offer approximately half the resistance of a square throat elbow.

controlled, a manual switch for summer control may be placed in the hallway, stairway, or other accessible location, but must not be placed where it is liable to be turned by mistake. This switch shall be so wired in conjunction with the automatic blower switch in the furnace bonnet that the blower cannot be stopped when the furnace is hot.

Section 3—Limit Control. A limit control shall be wired in conjunction with any automatic temperature control, to prevent overheating of the heater unit. This control shall be set at a temperature not higher than 250F. The customary setting is not more than 30F higher than blower control setting.

Section 4—Coal, Hand-Fired. The control for a hand-fired coal heating unit shall consist of a room thermostat operating an electric motor for opening and closing the furnace dampers. The same shall incorporate limit controls. See Section 3.

Section 5—Coal, Stoker-Fired. The controls for a stoker-fired heating unit shall consist of a room thermostat, limit control, a relay for operating stoker motor, and some form of hold fire control, such as high-low stack switch or time interval contactor.

Section 6—Oil Fired. Where the heating unit is oil fired, use standard controls furnished with oil burner. The same shall include room thermostat, limit controls, pyrostat, or other approved ignition control.

Section 7—Gas Fired. When the heating unit is gas fired, the controls shall consist of a room thermostat, limit control, and approved safety devices to close and vent the gas line.

Section 8—Zone Controls. The controlling of larger installations by zone controls is advisable. Such controls consist of thermostats operating dampers in warm-air ducts leading to certain portions of the residence. Unless familiar with the operation of zone controls, consult representative of manufacturer of control desired.

Section 9—It is imperative that the owner furnish a separate circuit of proper voltage and capacity to be run from the house service to a separate panel. This panel is for the *heating equipment only*.

Article 8—Construction Details

Section 1—Stacks. Stacks shall be constructed of IC tin or 28 gage galvanized iron. It is advisable to wrap all warm-air stacks with one layer of 10-lb. asbestos paper. All joints shall be stripped with asbestos paper. Where stack heads, boots, or other fittings, either for warm-air or return air go through the first floor, all openings around such fittings shall be filled with asbestos fiber or other noncombustible insulating materials to make this opening gas- or dust-tight.

Section 2—Round Pipe Trunk Line. Round pipe trunk line shall be constructed of galvanized iron: up to 14 in. — 26 gage; 18 in. — 24 gage; larger than 18 in. — 22 gage. If slip joints are used, joints shall be stripped with asbestos paper.

TABLE 11—PROPERTIES OF DRY AIR

Temperature, Deg. F.	Weight of Air, Lb. per Cu. Ft.	Per Cent of Volume at 70F
0	0.08636	0.868
10	0.08453	0.8867
20	0.08276	0.9057
40	0.07945	0.9434
60	0.0764	0.9811
65	0.07567	0.9905
70	0.07495	1.000
75	0.07124	1.0095
110	0.06968	1.0756
115	0.06908	1.0850
120	0.06848	1.0945
125	0.0679	1.104
130	0.06732	1.1133
135	0.06675	1.123
140	0.0662	1.132
145	0.06565	1.1417
150	0.0651	1.1512
155	0.0645	1.1620
160	0.06406	1.1700

Section 3—Rectangular Duct Trunk Line. Rectangular ducts shall be constructed of galvanized iron: up to 12 in. wide, use 28 gage; to 18 in. wide, 26 gage; to 30 in. wide, 24 gage; above 30 in., 22 gage. All ducts 24 in. or wider shall be cross broke on top and bottom and shall have standing seams or angle iron braces. All joints shall be S and drive strips, or locked. *No warm-air duct, round or rectangular, shall come in contact with masonry walls.* Insulate around warm-air ducts through masonry walls with not less than ½ in. of insulation.

Section 4—Individual Round Pipes. Individual round pipes up to 12 in. in diameter may be constructed of 26 gage galvanized iron or IX tin.

Section 5—Return Air Liners. Bottoms of all return air joist spaces shall be lined with smooth air-tight material. Capacities shall be figured at 80% of round pipe equivalent.

Section 6—Insulation. Insulate all exposed warm-air ducts in attic space or under unexcavated unheated sections, with not less than two layers of air cell asbestos paper or equal. In cold attic spaces more insulation is desirable.

Section 7—Duct Supports. All ducts shall be securely suspended from adjacent building member.

Section 8—Volume Dampers. Volume dampers of locking type must be placed in each warm-air run, from 6 to 12 in. from the main trunk. Splitter dampers may be necessary at any branch. Return air ducts *should* be similarly equipped and outside air inlet *must* be similarly equipped.

Steam-Heated "Long House" for Indians

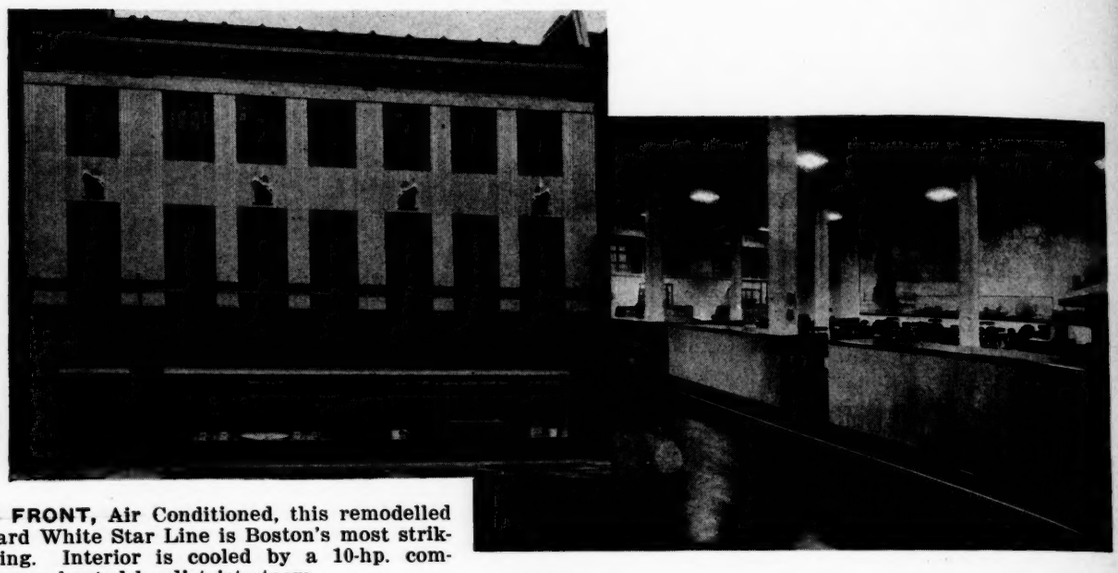
ON the Tonawanda Reservation at Akron, N. Y., where Indian tribal leaders still meet in a "long house," Uncle Sam has made preparations to build a modern steam-heated tribal building.

The Works Progress Administration and New York State's Social Welfare Department have decided to give the Senecas the white man's most up-to-date comforts.

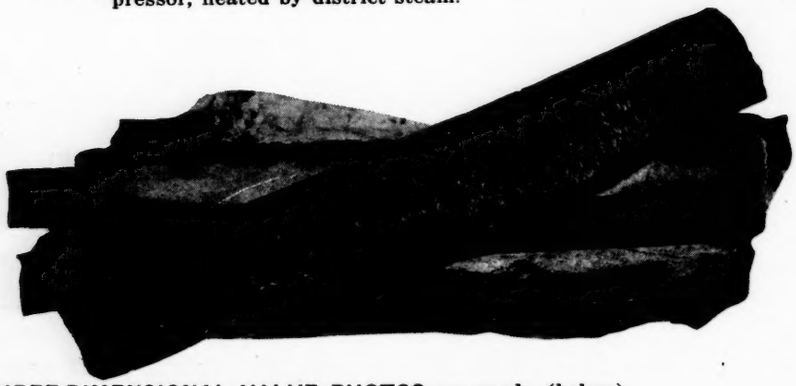
The building will be built along an Indian design—a "long house" with a palisade around it. Officially, it will go by the name Tonawanda Community Center. Its cost is $35,000. Near its comfortable council room will be an auditorium, showers, library, and museum.

PICTURE PARAGRAPHS

S. S. QUEEN MARY is the name of this streamlined oil truck, owned by Goodall & Creary, Portland (Ore.) oil dealers, and is the flagship of eight trucks, used to deliver fuel oil. Oil can be pumped several hundred feet from tank to building.



BLACK GLASS FRONT, Air Conditioned, this remodelled building of Cunard White Star Line is Boston's most striking office building. Interior is cooled by a 10-hp. compressor, heated by district steam.



30-YEAR OLD CORK COVERINGS (left) made by Armstrong Cork Co., found to be in excellent condition during the recent replacement of steam lines in the Capitol, Washington, D. C.

THREE-DIMENSIONAL VALVE PHOTOS are made (below) by George W. Wheelwright, left, of Polaroid Corp., at the Hancock valve factory.

CANDID CAMERA at the International Sales Convention of Iron Fireman, held in Cleveland, catches (below) president T. H. Banfield, third from left, as he delivers his annual address. Applause by (left to right) T. Henry Body, Iron Fireman director, Chicago; W. K. Fitch, president, Dravo-Doyle Co.; C. T. Burg, Iron Fireman general sales manager, and E. C. Sammons, vice-president.

What Several Hundred Oil Burner Tests Show

By ARTHUR H. SENNER†

The Bureau of Agricultural Engineering of the U.S. Department of Agriculture has, over a period of years, run hundreds of oil burner tests in an attempt to obtain information for prospective buyers of this equipment. The author, in charge of these tests, here summarizes results of these tests with particular reference to the performance of different kinds of burners in various boilers, including round, sectional, special oil burning boilers, and boiler-burner units. The article is abstracted from the author's paper entitled "Domestic Oil Burners" presented before the Fuel and Oil and Gas Power divisions of the American Society of Mechanical Engineers at its annual meeting recently.

TABLE 1 presents test data resulting from the operation of four principal types of domestic oil burners in three cast-iron boilers. The data present the performance at miscellaneous and widely divergent air-fuel ratios and fuel rates, and therefore may not be used to compare the efficiencies of combustion of the various types of burners. The purpose of this table is to compare the results obtained in using the simple engineering gas analyzer with those obtained by using the more complete gas analyzer. The analyses as presented in Table 1 were made after equilibrium had been reached.

If only the simple gas analyzer had been used the values contained under the columns of C_2H_4, H_2, and CH_4 would be lacking. The two columns of percentages of excess air or deficiency show the differences between the computed values of air-fuel ratios when the computations are based on what might be termed the incomplete and the complete analyses. When based on the complete analyses in which practically all the unburned gaseous fuel is included, the air-fuel ratio is less than when based on the relatively incomplete data yielded by the ordinary engineering gas analyzer.

The first two runs listed were conducted on a blue-flame vertical rotary burner with air deficiencies for the purpose of studying the products of incomplete combustion under such conditions of operation.

The percentages of the heat value of the oil represented by the products of incomplete combustion are indicated by that heading. The sum of the losses due to C_2H_4, H_2, and CH_4 which would not be detected by the ordinary gas analyzer are in some instances greater than the loss due to CO in the flue gases, the only product of incomplete combustion which would be detected in the so-called incomplete analysis. The values of the total incomplete-combustion losses are interesting, varying as they do from a low value of 4.1% to a maximum value of 22.2%. It is of interest to note that during the operation of the burner under the latter conditions, when nearly one fourth of the fuel passed up the stack unburned, comparatively little soot was produced. The value of the incomplete-combustion loss in one instance, with considerable air deficiency, was greater than the sum of the dry stack loss and the loss of heat in the moisture resulting from combustion of the H_2 of the fuel. Even when adequate air was supplied, the unburned-fuel loss averaged two thirds of the dry stack loss and usually exceeded the loss in the moisture resulting from combustion of the H_2 of the fuel. The last two columns of Table 1 are interesting in that they indicate a much better accounting for the total heat of the fuel when the heat balance is based on the complete combustion rather than on the incomplete combustion. The average value of the radiation and unaccounted-for loss based on the ordinary gas analyzer for the several runs listed is 12.6%, while based on the complete analysis it is 5.7%. Assuming a radiation loss of 3% in both cases, this would leave net unaccounted-for losses of 9.6% and 2.7%, respectively.

Thus, while the ordinary engineering Orsat apparatus is quite useful and perhaps indispensable in the field adjustment of oil fires, it is obviously not entirely satisfactory when an accurate heat accounting is to be made in precise laboratory work. Since the carbon-monoxide measurement is of relatively little value by itself, it is the belief of the author that the most practicable type of gas analyzer for the oil burner man who is confronted with the task of making oil burner adjustments in the field is the single pipette variety utilizing a caustic solution for the absorption of the CO_2.

In the following presentation of test results an

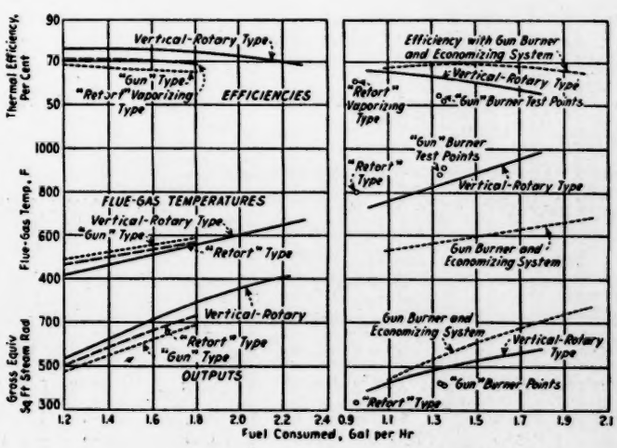


Fig. 1. (Left) Performance of oil burners in a 6-section, 22-in. round boiler. Fig. 2. (Right) Performance of oil burners in a 4-section, 20-in. round boiler.

†Associate Mechanical Engineer. Division of Structures, Bureau of Agricultural Engineering.

TABLE 1.—COMPLETE HEAT BALANCE

Burner Type	Boiler Type	Fuel Rate, Lb. per Hr.	Flue Gas Analysis (Percentages by Volume) CO_2	C_2H_4	O_2	CO	H_2	N_2	CH_4	Excess or Deficiency of Air (computed per cent) Based on Ordinary Orsat	Based on Complete Analysis	Stack Temperature, F
Blue flame												
Vertical rotary	S-2206	10.4	13.75	0.00	1.25	1.60	0.80	82.05	0.55	— 2.9	— 7.6	455
Vertical rotary	S-2206	10.4	12.10	0.35	1.35	5.10	0.70	79.80	0.60	—15.5	—21.4	385
Vertical rotary	S-2206	8.9	12.70	0.00	4.05	0.60	0.35	82.20	0.10	10.8	10.5	430
Gun	W-2004	11.6	9.40	0.00	8.90	0.80	0.60	80.10	0.20	41.7	39.8	638
Retort type	S-2307	8.5	11.00	0.00	6.50	0.10	1.00	81.30	0.10	32.3	30.1	399
Air atomizing	S-2307	19.5	9.20	0.10	8.20	0.40	0.80	81.30	0.00	53.1	47.8	750
Air atomizing	S-2307	19.1	12.90	0.40	3.40	0.40	0.50	82.40	0.00	11.8	4.5	740
Air atomizing	S-2307	19.1	6.90	0.35	11.30	0.50	0.40	80.55	0.00	96.3	79.7	850

effort has been made to select the most important illustrative data from an enormous mass of burner-boiler performance records which have been obtained over a number of years.

In the limited space available performance data are presented for the following installations: Typical domestic oil burners in several common types of house-heating boilers, originally designed for the use of coal; one of the poorer boilers when fitted with one of the economizers designed to improve the efficiency of such boilers; one of the commonly used types of special oil burning boilers with a conversion oil burner; and one of the modern special burner-boiler units.

One of the types of coal burning boilers which will be discussed in connection with the following performance data is the familiar cast-iron round boiler. This type of boiler is made up in sections consisting of the base, firepot section, one, two, or three intermediate sections, and a dome. If one intermediate section only is used the boiler is referred to as a 4-section boiler, consisting of base, firepot, one intermediate section, and the dome. Similarly, if two intermediate sections are employed the boiler is referred to as a 5-section boiler, and if three intermediate sections are employed the boiler is referred to as a 6-section boiler, which is the maximum ordinarily encountered. The 4-section boiler is the one with the minimum of flue travel or secondary heating surface and the 6-section boiler contains the maximum of secondary heating surface. Since the secondary heating surface is of relatively greater importance with some types of oil burner than it is in the burning of coal, the presence or absence of the intermediate sections makes considerable difference in the efficiency of such boilers when used with oil burners.

The boiler referred to by its manufacturer as the water-tube type, has rectangular sections assembled in the vertical plane. Obviously, increasing the number of sections in this type of boiler increases the combustion volume as well as the primary and secondary heating surfaces. Boilers such as these are made in several widths, and in various lengths depending upon the number of sections. The particular boiler of this type used in the Bureau's test was of the 23-in.-wide series and was composed of seven sections.

The test results from the operation of one of the most recent cast-iron special oil burning boilers, a product of one of the leading manufacturers, has also been included in order to afford a comparison between its efficiency and the efficiency of the commoner types of cast-iron boilers, that were originally designed for the burning of coal fuel on a grate.

In order to bring the picture up to date the performance characteristics of one of the most recent models of specially designed boiler-burner units has also been included. The particular type selected is of steel construction and fired by a pressure-atomizing burner. Both the special cast-iron oil burning boiler and the steel boiler-burner unit had incorporated in them the coils for domestic water heating.

The performance data of the several pieces of equipment are presented in graph form in Figs. 1 to 5, incl., in each of which the horizontal coordinate is the fuel consumption in gallons per hour and in which the three sets of vertical coordinates are, respectively, thermal efficiency, flue gas temperature, and output in terms of gross equivalent square feet of steam radiation.

TABLE 2.—PERFORMANCE SUMMARY, OIL BURNER TESTS

	6-Section Round Boiler			4-Section Round Boiler			7-Section Water-Tube Boiler			Special Oil Burning Boiler	Boiler Burner Unit
	Burner			Burner			Burner			Burner	Burner
	Rotary	Retort	Gun	Rotary	Retort	Gun	Rotary	Retort	Gun	Rotary	Gun
Efficiency, per cent..	76	70	66	63	56*	54	76	72	72	72	82
Flue gas temperature	520	540	560	850	875*	900	490	490	530	650	350
Gross output, sq. ft. of steam radiator..	730	700	640	500	475*	425	900	850	850	700	620

*Estimated from available test data.

TABLE 1.—COMPLETE HEAT BALANCE

Useful Heat B.t.u. per Lb. of Oil	Per Cent of Heat Value	Incomplete Combustion Loss, (Per Cent of Heat Value of Oil) C_2H_4	CO	H_2	CH_4	Total	Dry Stack Loss, Per Cent of Heat Value	Loss Due to Combustion of H_2, Per Cent of Heat Value	Heat Value, B.t.u. per Lb. of Oil	Radiation and Unaccounted Loss Per Cent of Heat Value Based on Ordinary Orsat	Based on Complete Data	Burner Type
												Blue flame—
14230	72.2	0.0	4.4	2.2	4.7	11.3	6.3	6.4	19700	10.7	3.8	...Vertical rotary
11564	58.7	4.1	12.0	1.7	4.4	22.2	4.4	6.1	19700	18.8	8.6	...Vertical rotary
14874	75.5	0.0	2.0	1.2	1.0	4.1	6.9	6.9	19700	8.8	6.6	...Vertical rotary
13000	66.0	0.0	3.4	2.5	2.6	8.5	13.9	7.1	19700	9.6	4.5	...Gun
14243	72.3	0.0	0.4	3.9	1.2	5.5	7.3	6.3	19700	13.7	8.6	...Retort type
11800	61.2	2.3	1.8	3.7	0.0	7.7	17.6	7.3	19300	12.2	6.2	...Air atomizing
13000	67.3	6.3	1.3	1.6	0.0	9.1	12.2	7.4	19300	11.9	4.0	...Air atomizing
9800	50.8	9.6	2.8	2.2	0.0	14.5	24.5	7.2	19300	14.8	3.0	...Air atomizing

It should be borne in mind that the comparison of test results are on the basis of thermal efficiency only. In selecting a burner for a particular installation the buyer would need to consider other factors, such as type of boiler and amount of service required.

In these tests the control of the burner by automatic devices was omitted, no attempt being made to determine the effectiveness or efficiency of this phase of the burner operation. In general the runs were of several hours' duration. The burner was always operated for a sufficient length of time preceding each test to insure steady conditions before readings were begun. The heat absorption was determined from a knowledge of the temperature rise of a known quantity of water passing through the boiler. Thus the boiler was operated as an ordinary Junker calorimeter. The "efficiency" plotted in the graphs may be defined as the ratio of the heat absorbed by the water in the boiler to the heat contained in the fuel supplied. In other words it is the proportion of the heat energy of the fuel which is actually transmitted to the heating medium, which in this case is water.

The output in gross equivalent square feet of steam radiation at any given fuel rate is equal to the fuel rate multiplied by the calorific value of the fuel in B.t.u. per gal. multiplied by the efficiency (expressed as a decimal), and divided by 240, which is the number of B.t.u. emitted in 1 hr. by 1 sq. ft. of standing cast-iron radiation of the steam type.

It was the purpose in the presentation of the data in Figs. 1, 2, 3, 4, and 5, to generalize as much as feasible. Accordingly, it was decided to present data for the three most common types of burners, based on the experiences of the author in the answering of hundreds of inquiries yearly. The three most common types are the vertical rotary type, the gun type, and the so-called retort type. As previously mentioned, the vertical rotary type of burner may be of the yellow-flame atomizing variety or the so-called blue-flame wall-wiping type. The efficiencies of these two types of burners were found invariably to be so nearly alike in all types of boilers studied by the Bureau of Agricultural Engineering that they have been classed together and referred to merely as the vertical rotary type when discussed from the standpoint of performance as depicted by the several graphs.

Reference will first be made to Fig. 1, which shows the performance of burners in a 6-section round boiler. The curves for the three types indicate that for this particular boiler the vertical rotary type shows the highest efficiency and the gun type the lowest, while the efficiency of the retort type lies between these two. Each of the efficiency characteristics is quite flat and either concave downward as in the case of the vertical rotary and retort types or practically a straight line as in the case of the gun type. (Each of the curves in Figs. 1 to 5 shows performance for the air-fuel ratios which would prevail in good practice for the several types of burners.) The flue gas temperature curves at the constant air-fuel ratios are straight lines over the range of fuel rate shown, and as would be expected they lie in reverse relative positions to the efficiency curves, the gun type showing the highest stack temperature, the vertical rotary showing the lowest stack temperature, and the retort type lying between the two. The output curves are either straight lines or slightly concave downward depending upon the form of the efficiency curves.

Fig. 2 shows the performance of the three types of burners in one of the types of cast-iron boiler which

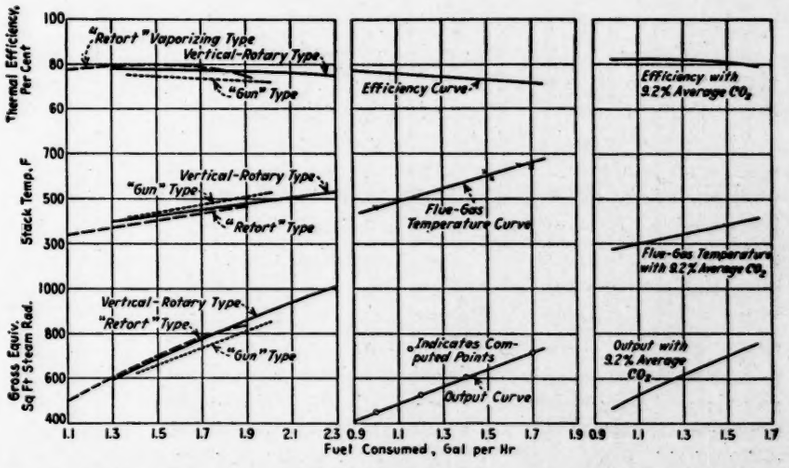


Fig. 3. (Left) Performance of oil burners in a 7-section, 23-in. water-tube boiler. Fig. 4. (Center) Performance of a vertical rotary burner in a special cast iron oil burning boiler. Fig. 5. (Right) Performance of a modern steel boiler-burner unit, having gun type of burner.

lends itself poorly to firing with the ordinary domestic oil burner. By way of contrast, the increased efficiency possible by the use of an economizing system for such relatively deficient boilers is shown in the graph labeled as performance "with gun burner and economizing system." Only a few individual test points are given for the "retort" vaporizing type and gun burner in Fig. 2.

The type of economizing system used for improving the burner performance consists of two principal parts: (1) A water-containing casting lined with refractory material, thus forming a combustion chamber and at the same time providing additional heat-absorbing surface which is tied in with the boiler by means of piping as shown. This provides what might be termed additional "direct" heating surface; (2) additional "indirect" heating surface is provided in the form of "extended" surface. This extended surface takes the shape of fingers of metal which "collect" heat and transmit it to the boiler walls and thence to the water. These components of the economizing system are not connected in any way, and therefore either one or the other may be employed or both, as was the case in the tests reported. Still other types of economizer take the form of water-containing castings which are placed in the firebox, but generally above the fire and above the combustion chamber itself. Such devices are also tied in with the boiler in a way that is similar in effect to that already described.

The reduced efficiencies and outputs and markedly increased stack temperatures in Fig. 2 over those in Fig. 1 are apparent, as is the marked improvement due to the addition of the economizing system. (The results will not be discussed in detail at this point, but will be treated later in tabular form which will draw direct comparisons between the several types of equipment under discussion.)

Fig. 3 shows the performance again of the three principal types of burners, this time in the so-called water-tube type of cast-iron boiler, originally designed for the burning of solid fuel. The performances of all of the burners in this unit were better than in either of the two types previously discussed and, in fact, it has been found that the performance of domestic oil burners in the water-tube boiler of adequate capacity approximates that obtained in the best of the units specially designed for the use of oil. There is relatively less difference between the efficiencies of the several types of burners in this boiler than in any other of the many types which the Bureau has investigated.

Fig. 4 has been included to show the nature of the results from a combination of a vertical rotary burner with one of the most common of the special oil burning boilers of the present day—one which is used as standard equipment by several burner manufacturers. The efficiency curve is also quite flat. The flue gas temperature graph is again a straight line, and the output curve assumes its characteristic form.

The ultimate in present day boiler-burner performance is probably represented by Fig. 5 which shows the results of the Bureau's study of one of the up-to-date units of this type. Again the respective graphs of efficiency, flue gas temperature, and output, all plotted against fuel consumption, are similar in form to those of the preceding figures, but it is apparent that the general performance is somewhat better than in the case of the types previously discussed. The efficiency is generally in excess of 80% and the flue gas temperature at practically all fuel rates is below 400F, which is about as good as could be desired in practice. It so happens that the boiler-burner unit referred to is of steel construction and employs the so-called "tankless" scheme for the generation of domestic hot water.

Perhaps the most interesting and profitable way to study the results of the operation of the different burners in the various boilers is to tabulate the several performances at those fuel rates at which they would most likely be used. Accordingly, Table 2 is presented.

In this table the performance is tabulated for the respective fuel rates at which the several boilers would probably be fired in everyday practice. The three items, efficiency, stack temperature, and gross output have been selected for comparison. In the two round boilers the vertical rotary burner shows the highest efficiency, lowest flue gas temperature, and largest relative output. The retort type burner lies between the gun burner and vertical rotary burner in performance.

In boilers of relatively adequate flue travel, such as the 7-section water tube, the difference in performance of the several burners becomes relatively small and the efficiencies of the retort and gun types become approximately equal under ordinary operating conditions. The efficiency of the boiler-burner unit shows what can be done when adequate flue travel is provided for the gun burner, yielding efficiency of 82% and stack temperature of only 350F. There is apparently a definite trend toward the use of the so-called gun burner in most of the boiler-burner units of today.

Another interesting fact was brought out in connection with the test of the economizing system which has not been included in the tabulation, but which can be seen by reference to Fig. 2. With the economizer and operating at a fuel rate of 1.35 gal. per hr., the efficiency becomes 69% as compared with 54% for operation of the gun burner in the plain boiler; the stack temperature is 580F instead of 900F; and the gross output is 560 sq. ft. of steam radiation as contrasted with 425 sq. ft. The use of such an economizing device should result in practice in the saving of approximately 25% of the fuel otherwise required to do a given heating job.

It should not be concluded from the foregoing that the comparative cost of heating is invariably inversely proportional to the efficiency of the boiler and burner. If all burners consumed the same grade of oil it would be substantially true that the fuel cost to do a given heating job would be approximately inversely proportional to the efficiencies of the boiler and burner combinations involved. It may be found that the differences in efficiencies of two types of burner under comparison may be more than offset by the difference in cost of the fuels supplied to the two types.

The difficulty involved in attempting to predict heating costs is shown by the following illustration. Investigations conducted by the Bureau of Agricultural Engineering showed that the seasonal cost of oil with a rotary wall-wiping blue-flame burner using No. 2 oil at 7½ cents per gal. was about 9 or 10% greater than the cost of heating with a pressure atomizing burner using No. 3 oil at 6½ cents per gal., when these burners

were used in a rectangular sectional boiler with liberal heat-absorbing surfaces. However, when used in a round boiler with rather limited heating surface the costs of oil were approximately equal, even though the No. 2 oil cost more per gallon than the No. 3 oil and in spite of the fact that the No. 3 oil contains a slightly larger number of heat units per gallon. It is important to note, however, that if the No. 2 oil had been supplied to both burners, which is commonly the case today, the cost of oil for the gun burner would have been higher than the cost of oil for the rotary burner in either type of boiler. In figures, the cost of oil for the gun burner in the round boiler would be about 18% more than that for the rotary, and the cost of the oil for the gun burner in the rectangular sectional boiler would be about 5 or 6% more than for the rotary. These figures obviously do not necessarily apply to all round boilers nor to all rectangular sectional boilers.

In conclusion it may be well to note that in selecting a burner for a particular installation there are other items, such as service and repairs, to be considered along with burner efficiency and fuel cost, and that when the different burner types are used with suitable boilers the differences in efficiency are not great.

Standard Specifications for Materials

USE of prepared specifications has increased very greatly since attention has been turned to the desirability of drawing them up. There are now a number of agencies for preparing authoritative, neutral and standard specifications for materials. When this kind of specification is used it usually takes the following general form:

"Castings shall be of gray iron made in accordance with ASTM specification (A126-30)."

In this particular case the specification referred to is one prepared by the American Society of Testing Materials—a technical society of engineers, designers, testing experts, manufacturers, users, and others interested in the properties of materials. Its work consists largely of preparing standard specifications and devising and standardizing methods of testing.

Before the specifier can really feel justified in calling for the use of a material produced under one of these specifications he will naturally want to know the procedure used in arriving at the specification in order that he can judge its reliability.

In the case of ASTM specifications, these are drawn up by committees. These committees are formed from the membership of the society and operate under definite regulations governing their procedure. These regulations are so framed as to insure adequate representation of producers and general interests and with the provision that producers may not predominate in the membership of any committee.

After a committee is formed, the members collectively draw up and discuss specifications intended to represent the best obtainable product which the state of the art will permit. Before this proposed specification has any standing, it is given the benefit of all possible criticism, both by direct appeal and by publishing it as a "tentative" standard in an annual book of tentative standards put out by the Society. This book states definitely that not only is the specification "tentative" but that specific comments and criticisms are desired. It may continue as a "tentative" standard for not less than one year and sometimes for longer periods. Before final adoption as a standard the committee takes cognizance of the suggestions and criticisms received during the period when it was a "tentative" standard. After having gone through this procedure, the tentative standard is eligible for formal adoption by the Society. If adopted it becomes an ASTM standard and is published as such.

It will be seen that in order to become an ASTM standard the specification must not only have been drawn up by a committee of experts having a membership which cannot be dominated by producing interests, must have passed through a fixed procedure, must have been published with an invitation for criticism and must then have been formally adopted by the Society. With all these safeguards drawn around the procedure it is apparent that an ASTM standard is a neutral specification, representing the ideas of the best talent which can be found to work on the subject.

Where such standards are in existence, the specifier can, and usually does, feel safe in using them.

Since the American Society for Testing Materials began its work, it has adopted nearly 500 standards and over two hundred "tentative" standards. These are, however, not all specifications as a good many of them reflect the Society's interest in testing methods.

ASTM specifications of interest to specifiers of heating, ventilating and air conditioning equipment include seven having to do with various kinds of pipe and tubing; one covering galvanized sheets; and two on iron castings. In addition, the Society has set up a tentative method for determining relative humidity.

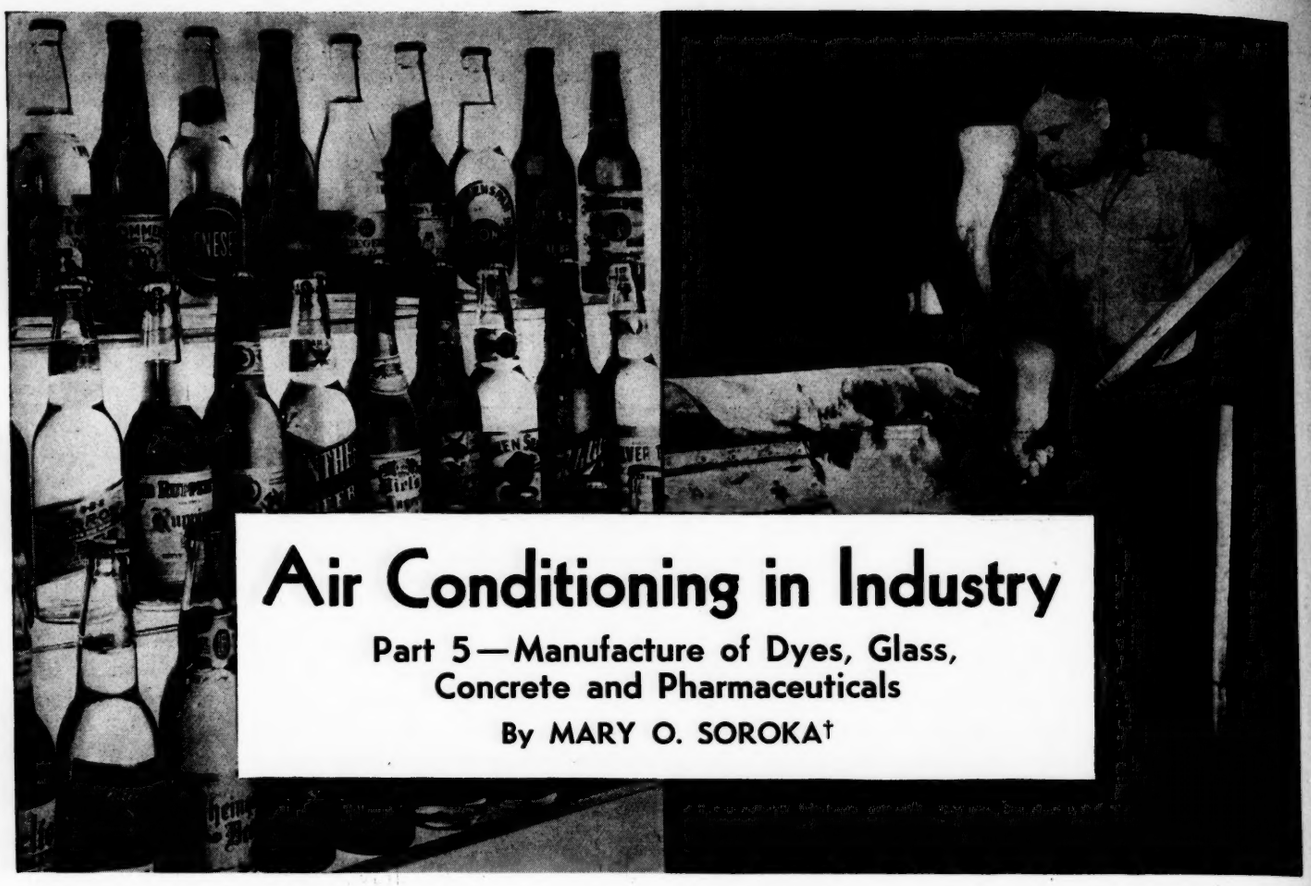
For reference purposes the specification and the corresponding number are listed herewith.

PIPE—Specifications for Standard Sizes:
- **1—Seamless brass pipe (B43-33)**
- **2—Seamless copper pipe and tubing (B42-33)**
- **3—Welded and seamless steel pipe (A53-33)**
- **4—Welded wrought iron (A72-33)**
- **5—Cast-iron soil pipe and fittings (A74-29)**
- **6—Welded and seamless steel pipe for ordinary uses, black and hot dipped zinc coated (galvanized) (A120-32T)—a tentative standard**

TUBING
- **7—Seamless bright annealed copper tubing (B68-33) (a scale free pipe much used for refrigeration lines)**

SHEET
- **1—Zinc-coated (galvanized) sheets (A93-27)**

GRAY IRON CASTINGS
- **1—For valves, flanges and pipe fittings (A126-30)**
- **2—Gray iron castings (A48-32T)—a tentative standard**



Air Conditioning in Industry

Part 5—Manufacture of Dyes, Glass, Concrete and Pharmaceuticals

By MARY O. SOROKA†

THE manufacture of some pharmaceuticals and serums during hot, moist parts of the year would be impossible without controlled air conditioning. When the moisture content of the air is increased, the drugs absorb water and clog up the machines which are used to form them into tablets. Increased moisture and temperature will render the gelatin in the capsules soft and unfit for use. Formerly some departments of drug manufacturers' plants were obliged to shut down completely in the summer months.

Before the days of automatically controlled air conditioning, low humidity was attained by passing the air through beds of charcoal in a large iron cylinder. There was no means for cooling the air, however, and the dryers required attention. The drug industry has the further requirement for absolutely clean air in sterile filling rooms where capsules and vials are filled. The tablet machine room, filling and packing room as well as test room should be maintained at 80F dry bulb and a relative humidity of 35 to 45%. Tablet forming is impossible when the relative humidity goes over 50%.

Pills and tablets must be dried to prevent a surface hardening of the coating. Such hardening results when drying in too dry an atmosphere. While the outside may appear hard, in several months the inside moisture comes through, resulting in sticky pills. With air conditioning the drying process is slowed so that the center is dried first, no moisture is sealed inside, and there is no scorching of pills in drying rooms.

Effervescing tablets (those tablets which give off large quantities of carbon dioxide when submerged in water) used to be made only in December, January, and February; even then the tablets often contained enough moisture to be useless when the bottle was opened. The desirable air conditions for this type are 90F and 15% relative humidity.

In kettles in which pills are coated, a concentrated sugar solution is added to the agitated mass. As the water evaporates each piece is covered with sugar crystals. A good coating is obtained by introducing into the kettle air at the right temperature and relative humidity. If the cooling and drying are too slow, the coating will be rough and nearly translucent; if cooled too fast, the coating will chip. By balancing the air conditions to the sugar solution a good coating is obtained.

Zinc stearate, the white powder used for dusting powder, is a precipitate from the chemical reaction of stearic acid and sodium carbonate. It must be dried before being ground to powder. In drying the stearate, low velocity air current aids in decreasing the drying period. A relative humidity over 35% prevents trouble from static electricity when metal containers are used, otherwise the particles will stick to the container.

Gelatin capsules used never to be manufactured during the summer months and even in winter the job was difficult. When the drying of capsules is complete, they are stripped from the molds or pins by automatic machinery and the parts fitted together. Capsule filling rooms are kept at a low temperature. If the pins are too warm the gelatin will flow by gravity down the pins, giving a capsule wall of variable thickness. Should the pins be too cold when dipped, the capsule walls

†Engineer, Julien P. Friez & Sons, Inc., subsidiary Bendix Aviation Corp., Baltimore, Md.

will be too thick and the two halves could not fit. The temperature range of the pins should not exceed 1F.

The processing of gland products is expensive because the raw material spoils readily as it is subject to contamination. Furthermore the therapeutic value of gland and other animal products is destroyed by processing at a temperature above 77F. One manufacturer has found it advisable to air condition the quarters of experimental animals.

Conditioned air dries bottles in thirty minutes. This formerly required from three hours to three days. The result is an economy of floor space and investment of equipment. Manufacturers wrap bottles in parchment paper to protect labels and keep the bottles clean. In low temperature dry air the parchment shrinks, cracks, and fails to protect, but the proper relative humidity prevents this. Small conditioning units can be provided for each department, designed for one process. Automatic control is used and recording instruments are a safeguard on performance. Service men collect the operation charts periodically to check conditions.

Dyes

The writer recalls a chemical plant in lower New York City which was able to carry on a variety of operations in one building entirely because of the air conditioning system. Manufacturing high grade pharmaceuticals and powerful dyes on different floors would be impossible without it. Grains of dye floating from one floor to the other could ruin the costly medicinal powders and it did not require more than a grain to produce damage.

Like other factories, different departments had individual air conditioning units, but it was not considered necessary on the floors used to fill dye containers and handle barrels of pharmaceuticals. On wet days, the floors become slippery as hygroscopic powders spilled on the floor and became wet. In the section for dyes, blowers were placed on the floors to dry them, but it was not a satisfactory solution because the powders were blown about. In addition to the hazard of slippery floors, the workmen who were covered with the powdered red dye were damp from the moisture of the hygroscopic powders, and walked about seemingly covered with gore. Efficient dust collectors would have solved the problem of dye powder recovery, but controlled air conditioning was necessary to remove the nuisance created by the hygroscopic powders.

Not only is air conditioning necessary for the manufacture of hygroscopic powders but in using them as well. By controlling the temperature and humidity in the shop in which the world's largest telescope mirror is being ground, polished, and parabolized, it is expected that six years of time will be saved.

Glass

A thin film of rouge is used to cover the surface of the lens and to act as a grinding compound. The time required for grinding and polishing is in direct ratio to the frequency of application of the rouge. The best conditions would be 98F and 50% relative humidity. However, since this is uncomfortable for the workmen a compromise of 77F and 50% relative humidity is planned.

Even the manufacture of sheet glass is improved through exact control of the air supplied to furnaces for combustion. Sudden weather changes, such as a change in wind direction, affect furnace control and make it difficult to produce glass of uniform quality. Another critical point in manufacturing is the forming of the sheet of glass, a step which is now done with the control of temperature, humidity, and air motion.

Drying of varnish is also an example of the control of the rate of chemical reactions. This is an oxidizing process dependent upon temperature. High relative humidities have a retarding action on the rate of oxidation at the surface and allow the gases to escape as the chemical oxidizers cure the varnish film from the bottom. This produces a surface free from bubbles and a film homogeneous throughout. Suitable temperatures for drying varnish vary with type but a relative humidity of 65% is generally beneficial.

Concrete

Concrete is hardly a material which is thought of as being sensitive to changes of weather. However, the enduring qualities of this building material are the result of laboratory tests in controlled conditions. In the studies of strength, durability, volume change, water tightness, and other qualities, sample blocks and cylinders are cured under controlled conditions. Resistance of concrete structures to weathering and moisture penetration depend somewhat on curing conditions as well as other physical factors such as water content of mix. Engineers must know precisely how each factor affects concrete and tests are carried on continuously in some laboratories. Continuous recording of temperature and relative humidity and automatic regulation are part of the general setup. Suitable air conditions are 70F and 50% relative humidity, with the curing room controlled at 70F and 100% relative humidity. The standard method of testing cement as adopted by the American Society for Testing Materials requires the temperature of the room, materials, and mixing water to be maintained at 70F with a relative humidity of the "moist closet" to be not less than 90% for the briquets.

Concrete is not usually considered as a raw material but the manufacturer who is doubtful of the benefits to be derived from carefully controlled air conditions may take the example of civil engineers for consideration. Concrete is manufactured outdoors and in the past not always under the most competent supervision so that it was impossible to trace failure. Was it the cement, the water content, proportions of sand to gravel, the weather, or what? Only the most rigid specifications for raw materials and laboratory testing could guarantee results for the contractor. The manufacturer must not only keep his product uniform but must be able to tell quickly when his output is faulty, whether it is raw material, handling in his plant, or the weather before too many machines are idle and too many workmen stand around waiting. Eliminating the two variables of temperature and humidity are a great saving of time in locating trouble.

There are numerous processes which have not been mentioned. The manufacture of granulated and tablet sugar, salt, starches, breakfast cereals, prepared baking

mixes, powdered milk, powdered malt products, silica gel, insecticides, munitions are some of the processed materials which also benefit from air conditioning. As manufacturing becomes more complicated, more air conditioning will be required. For example, the factory slicing of bread caused more moisture evaporation and mold contamination. When a loaf was wrapped unsliced, the temperature of handling was higher and there was a shorter period of exposure to the atmosphere while cooling, thereby reducing the chances for mold contamination. It has been said that industrial air conditioning installations may be expected to pay for themselves every two years.

This is the fifth of a series of articles dealing with air conditioning for industrial processes. The sixth, describing the effect of air conditioning on the efficiency and comfort of employes, will appear in the next issue.

Instruments for Recording Factors Affecting Comfort

COMFORT in so far as heat or cold is concerned is associated with a normal heat balance between heat production and heat loss, at normal body temperature, and without sweating. Four of the basic factors affecting human comfort are air temperature, radiation, air movement, and humidity. No one is independent of the other, but their effects are quite different under conditions of minimal or maximal perspiration.

In ordinary conditions the rate of heat loss from the body and the degree of comfort experienced depend largely upon the effects of radiation and convection.

The ordinary thermometer fails to give an indication of these effects because it is not sufficiently affected by radiation and little if any by air movement. A room may feel too cool at 75F or too warm at 60F, depending upon these radiation convection effects.

The effective temperature index also fails in this respect because it does not allow for radiation effects, and it overestimates the influence of humidity at ordinary room temperatures.

The dry Kata thermometer is oversensitive to air movement while the wet Kata is oversensitive to both wet-bulb temperature and air movement.

Various instruments have been devised to register these radiation convection effects for the purpose of ascertaining the relative comfort of various environments and for studying the effectiveness of different methods of heating and ventilation. The principal ones are (a) Dufton's eupatheoscope, (b) Vernon's globe thermometer, (c) Winslow and Greenburg's thermo-integrator, and (d) Yaglou's heated globe.

The eupatheoscope is an elaborate laboratory instrument designed especially for conditions prevailing in England. Modification is necessary for use in hot weather. It is not entirely suitable for routine measurements in the field, and the cost is quite high.

Vernon's globe thermometer is the simplest of all. It consists of a 6-in. blackened copper sphere with an ordinary thermometer in the center. It is best suited to rooms heated by radiant methods. Its readings are sometimes misleading in rooms heated by convection methods. For instance, if the surrounding walls and glass are below air temperature, the globe will indicate in still air a temperature below that of the air, but if the air is set in motion the globe temperature will increase, approaching the temperature of the air as the velocity increases. Thus the cooler of the two conditions (that with high air movement) would give the higher reading on Vernon's globe. When the air and surrounding surfaces are at the same temperature, Vernon's globe records air temperature.

The thermo-integrator is a decided improvement over the eupatheostat with respect to both principle and operation. It consists of a blackened hollow copper cylinder 24 in. long and 8 in. in diameter, with hemispherical ends, containing an electric heating element of 21.5 watts (a storage battery furnishes the current). This is equivalent to a heat dissipation by the instrument of 17.5 B.t.u. per sq. ft. per hr. Eight iron-constantan thermocouples are distributed over the surface of the instrument, and the mean surface temperature is recorded automatically. This gives a valuable index of the radiation-convection condition.

The heated globe thermometer consists of 2 or 3 hollow spheres, one inside another, with air spaces in between to simulate the air spaces in between the clothing of a man. The outer sphere is a blackened standard 6-in. tank float. The innermost sphere contains a heating element of variable resistance suitable for connection to the ordinary lighting circuit. The heat input is kept constant for any particular scale, but the amount can be varied by adjusting the resistance from a minimum of 15.3 B.t.u. per sq. ft. per hr. for men at rest, to a maximum of 75 B.t.u. or more for men at work, thus giving a variety of scales for various rates of work. During the heating season the electrical input is at the rate of 15.3 B.t.u. per sq. ft. per hr. for men at rest, and the surface of the outer sphere is kept dry. In summer the heat input is increased to 20.5 B.t.u. per sq. ft. per hr. and the lower half of the globe is moistened by fitting on a knitted woolen cap with a tassel which dips into a small bottle of water. When physical work is done at a rate which induces general sweating, the whole surface of the globe must be covered with a wet cloth and the electrical input increased to correspond with the total metabolism. An ordinary glass thermometer inside the outer air space of the instrument registers a temperature comparable to that existing in the human body between the two outer layers of clothing. The readings of such a globe thermometer seem to be closely related to sensations of warmth and comfort induced by various air conditions.

How valuable the thermo-integrator or heated globe may be as a measure of atmospheric comfort remains to be seen.—*The above material has been abstracted from a report of the Sub-Committee on Physical Procedures in Air Analysis of the American Public Health Association.*

National Oil Burner Show Draws 8600 to 76 Exhibits; Health and Other Aspects of Air Conditioning Discussed

FORTY-SIX hundred engineers, dealers, salesman, manufacturers, contractors, and others connected with the trade were registered at the National Oil Burner and Air Conditioning Exposition held at the Convention Hall, Philadelphia, March 15-19. In addition an estimated 4000 homeowners and prospective buyers attended the show. In connection with the exposition the Oil Burner Institute held sessions of interest to engineers, manufacturers, dealers, oil companies, and the general public.

Conditioned Air Not Sterile

In a special lecture on winter air conditioning Elliott Harrington, engineer in the air conditioning department, General Electric Co., gave a concise, non-technical discussion of this subject. In his talk Mr. Harrington told his audience that during the period when he was living in the air conditioned proving home in Schenectady his young son did not miss even one-half day at school during the two years, whereas both before and since that period the boy has lost time from illness.

In connection with a frequently mentioned objection to air conditioning Mr. Harrington said: "Some of you might feel that by air conditioning the enclosures in which we live and work, we are likely to produce a new type of human being who lives in a state of good health, while in air conditioned spaces, but develops no immunity to concentrations of bacteria which he might contact in spaces not air conditioned.

"In this connection there is a classic medical experiment in which a litter of rabbits was separated into two groups. One group was brought up under perfect conditions, with sterile air, sterile food, in fact sterile everything. The other group was allowed to run the fields as normal rabbits would. The rabbits living under the sterile conditions grew a little larger and their coats were a little softer than those of the rabbits who had to shift for themselves, but when the pampered ones were left out and allowed to run the fields, they promptly died because they had developed no immunity to ordinary conditions. Fortunately, it would be quite impossible in present types of building construction for us as air conditioning engineers to produce these absolutely sterile conditions, because in any enclosure there is a complete replacement of the inside air by outside air about once per hour, thus bringing in a new charge of dust and bacteria. Therefore, we do not produce sterile air. We simply avoid concentrations of bacteria which the normal body cannot fight off. It is for this same reason that a case of smallpox is quarantined because the bacteria concentration in the home of the smallpox victim is so great that the average human cannot fight it off. The normal body is entirely able to take care of itself under average bacteria distribution. The medical profession tells us that it is the bacteria concentrations that cause trouble."

Effects of Refinery Practices on Fuel Oil Supply

Harry F. Tapp, assistant to the president, Gilbert & Barker Mfg. Co., presided at the technical session held in the morning of March 16. In this session Dr. R. T. Goodwin, manager fuel oil sales department, Shell Union Oil Corp., presented his paper on "Fuel Oil—A Major Petroleum Product." According to Doctor Goodwin: "Several changes are now taking place in the 'composite refinery picture,' because the domestic oil burner has created an unprecedented demand for distillate fuel oils. This demand has forced the refiner to classify distillate fuel oils in the principal product class, to share this distinction with gasoline. The demand for fuel oils places a direct and definite responsibility on the petroleum industry to meet this demand in the same satisfactory manner they have met the ever increasing motor fuel demand.

"It is my opinion that the American Petroleum Industry should not continue to feel obligated to meet the increasing demand for heavy fuel oils (Bunker C or No. 6) if it necessitates a sacrifice in the yield of distillate fuels. It is recognized that considerable quantities of heavy fuel oil are consumed annually in under-boiler service for steam raising and were originally sold in competition against coal employing purely a coal/oil parity basis. In these cases fuel oil does not possess any real advantages and cannot be priced to include any increased return for the desirable properties of a liquid fuel. This coal/oil parity market is becoming less and less attractive to the fuel oil producer and especially for the refiner operating on high grade gasoline producing crudes, for in such cases heavy fuel oil production will be incidental to the balancing of the gasoline and distillate fuel oil demands.

"Now that distillate fuels have attained the major product class, it will be necessary for them to share a greater part of the cost of the raw material and contribute a greater portion of the total income of the industry. Considered in another way, a barrel of crude will yield only a certain total number of gallons of distillate products and the increase in yield of either gasoline or distillate fuels is at the expense of the other. To still further complicate the job of balancing the yield of various petroleum products, several consumption records were broken for the year 1936."

Dr. Goodwin went on to say that: "The large consumption of domestic fuel oils during the 1935-36 heating season showed for the first time that these requirements exceeded the usual relationship with gasoline demand. The refiners' problem today is how to produce more distillate fuel and less gasoline of the required octane rating. A few recent developments in the science of refining are assisting with this problem, such as reforming, polymerization, viscosity breaking, and non-residuum cracking. In the non-residuum cracking the final product is a solid coke, rather than a liquid fuel, and this operation yields a greater percentage of distillate products. This refining method will prove very valuable in establishing the proper production relation between gasoline and fuel oil.

"The very rapid sale of oil burners has further complicated the supply situation. However, there is one definite way in which the oil burner industry can assist the refiners in producing an adequate supply of fuel oil at a fair price. This assistance should be in the form of an earnest endeavor to reduce the number of grades of fuel now demanded for tank wagon delivery. It is well known that we are operating more than twenty-six million automobiles in this country on two primary grades of gasoline. It should be possible to operate all of the 350 or more different makes and models of domestic oil burners on two grades of fuel oil. The recommended grades would be a light fuel of kerosene type for use in range, pot type, and those requiring a No. 2 fuel, a second grade for the domestic burners designated for No. 3 and No. 4 fuels. For the commercial burners, a fuel with a viscosity of approximately 200 sec. Saybolt Universal at 100F should suffice. The simplification of grades would eliminate refinery equipment, duplicate storage lines, simplify bulk transportation, retail storage facilities, trucks, etc. In order to operate a large number of different makes and models of domestic oil burners on this minimum number of grades, it is absolutely necessary that the product be of the highest possible quality."

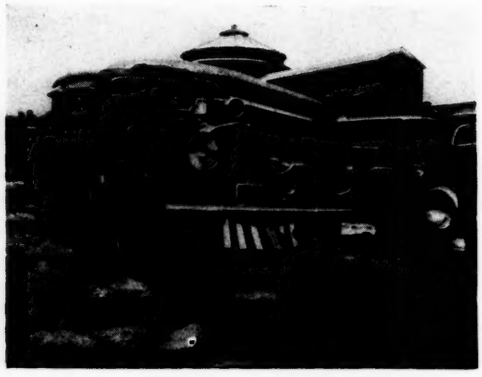
(Text concluded on page 64)

At the National Oil and O. B. I.

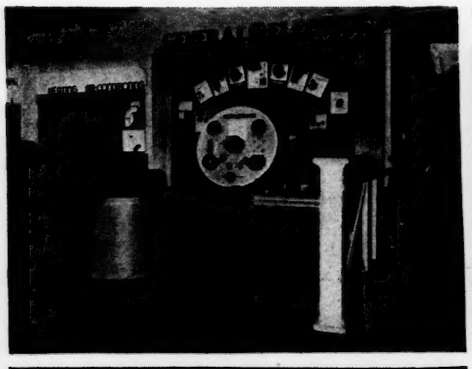
Philadelphia, March 15 to 19

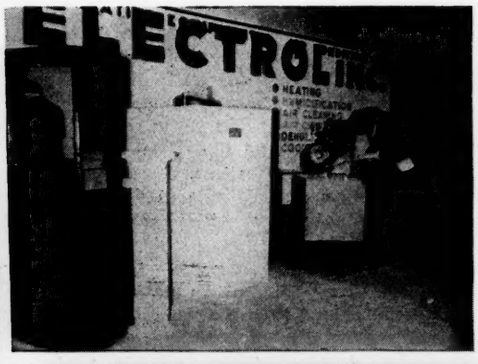
Dr. C. A. Mills, professor of experimental medicine, University of Cincinnati, who spoke on the health aspects of air conditioning and urged the lessening of contrast between indoor and outdoor temperatures.

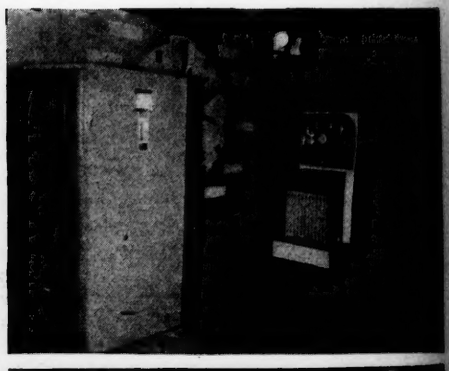
The economies of air conditioning in home and business were stressed by J. K. Knighton, manager of the air conditioning department of Nash-Kelvinator Corp. He pointed out that ladies ready-to-wear stores on the average increased their sales 34% through air conditioning.

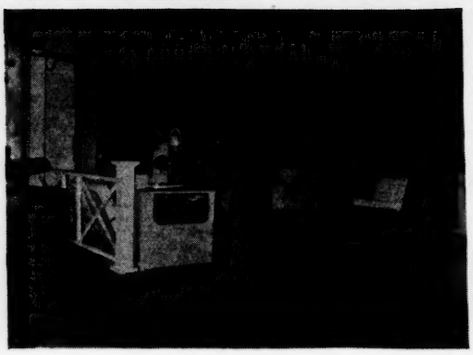


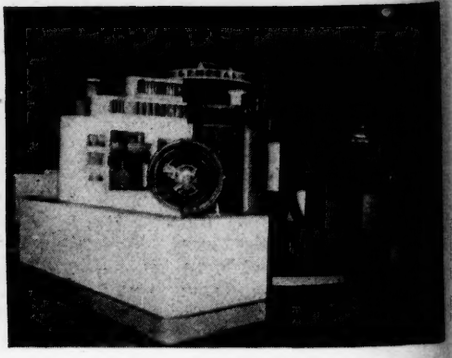
Doe oil burners are displayed to prospective dealers by means of this unusual auto and trailer.











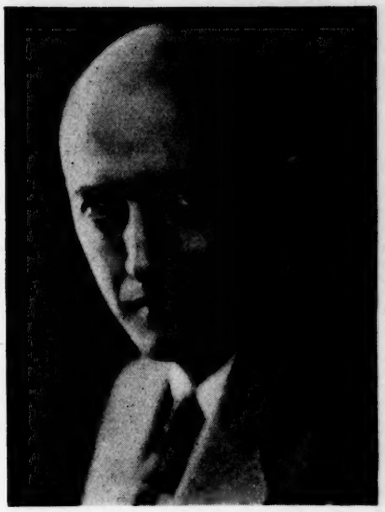
A Few of the Booths at the Oil Burner Show

Top—One of two displays by General Electric, this one being devoted to motors and electrical equipment. A complete line of winter and summer air conditioning controls were exhibited at the Mercoid booth, shown below.

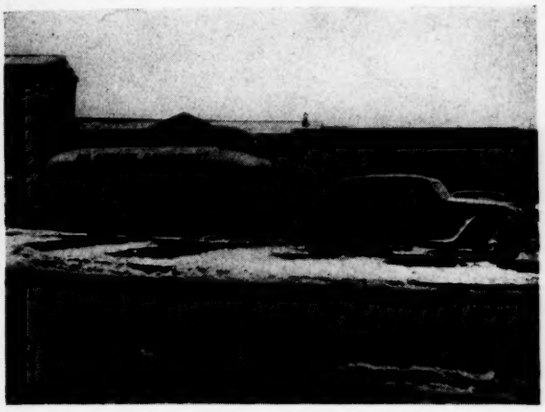
The Electrol booth, which occupied a corner position, was too large to be shown in one view. View at the top shows about half of that company's display. Below is shown the exhibit of Automatic Products Co., of Milwaukee.

Above—Oil-burning equipment as well as the company's slenderized radiators were shown by Burnham Boiler Corp. Air conditioning equipment made by General Electric Company is shown in the lower view.

Burner Show Sessions

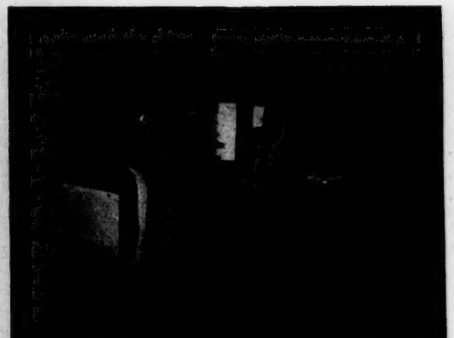


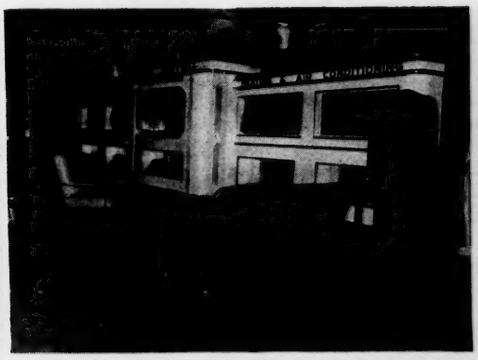
Elliott D. Harrington, General Electric engineer, who presented a well prepared non-technical paper on winter air conditioning. Mr. Harrington said that probably the most important and probably the least understood of the elements of air conditioning is air purification.

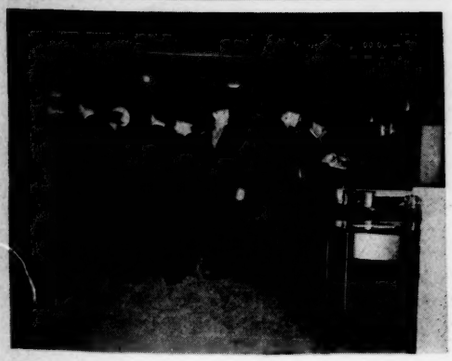


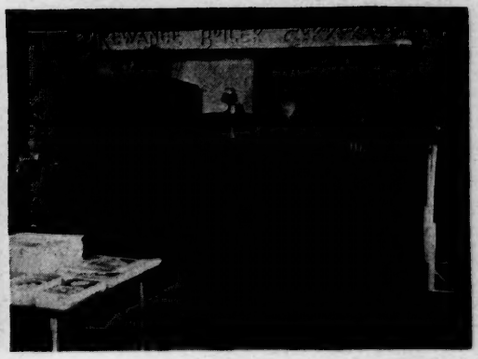
The auto-trailer combination used by May Oil Burner Corp. Both car and trailer are finished in a robin's egg blue with silver trimmings.

The effect of balanced utilization of petroleum products on the future supply of domestic and industrial fuel oils was explained by Dr. R. T. Goodwin, manager of the fuel oil department of Shell Union Oil Corp. Doctor Goodwin estimated that over 60 million barrels of oil were used for building heating in 1936.









More of the Booths at the National Burner Show

The upper view shows the attractive and large exhibit of the Detroit Lubricator Co. Below, a group of visitors watching McDonnell & Miller's sound motion picture display.

The compact and well arranged exhibit of Minneapolis-Honeywell Regulator Company is shown in the photograph above, while H. A. Thrush & Co. exhibits its hot water system as shown in the view below.

The top illustration shows the American Radiator Company's exhibit in the foreground. To the left of it is the Kewanee Boiler Corporation booth, also shown in more detail in the photograph at the bottom.

No Oil Scarcity Foreseen

In connection with the question in many peoples' minds regarding the length of time the company's oil reserve will last, Doctor Goodwin said: "For several reasons the problem of petroleum reserves should not be a source of concern to those interested in the sale of oil burners and fuel oils. First, the geologist and engineer has replaced the old time prospector who located wells by means of the divining rod or intuition. The success of these modern methods is demonstrated by their uncanny ability to predict the presence of oil and the actual depth at which it will be found. Second, the modern refining methods have increased the yield of the more valuable products as shown by the fact that in 1914 only about 1/6 of a barrel of crude was converted into gasoline, while today, through cracking, polymerization and other engineering improvements, the average yield has been increased to 44%. Third, it is estimated the shale oil reserves located in our western states would be sufficient to supply our present rate of consumption for more than 100 years."

Willis H. Carrier, chairman of the board, Carrier Corp., addressed the Institute on "Technical Aspects of Air Conditioning." In his address Mr. Carrier said: "Uniform external temperature over the body is perhaps the greatest essential in the prevention of colds. One reason why we benefit by going to bed when we have a cold is uniform temperature and warmth. The reason why we avoid drafts—lack of uniform temperature. The reason why we can stay outdoors in the coldest weather without catching cold—uniform temperature. With the stove and fireplace our ancestors always had cold floors. That is one of the greatest reasons why indoor heating was thought to be so unhealthful.

"With these considerations in mind we cannot fail to realize the necessity of two fundamental and essential features in air conditioning. First, prevention of cold air from the windows stratifying along the floors, and second, uniform temperature obtained by continuous supply of heat and circulation. For by uniform heating only can healthful heating be assured."

Suggests Radiant Heating

Following Mr. Carrier's talk, a paper was presented by Dr. C. A. Mills, professor of experimental medicine, University of Cincinnati, on "Health Aspects of Air Conditioning." In his paper Doctor Mills said that he believed that there was an urgent need for the development of air conditioning whereby heating loads from the body could be properly controlled without regard to air temperatures or humidity and went on to say: "For a couple of years I have had an idea such an end could be achieved through radiant heat means, and this winter I have had a chance to demonstrate that it can actually be done.

"Suffice it to say that one can be made quite comfortable at air and wall temperatures of 92-95F by removal of the body's heat as radiant heat; and likewise at low air temperatures (30-50F) comfort can be readily achieved by radiant heat introduction. Heat reflective wall surfaces are an essential part of the setup, for various experimenters have found the cost of cooling or warming all wall surfaces too prohibitive for practical application. With heat reflective wall surfaces, however, wall temperatures become unimportant; in fact, the walls assume air temperature levels. Here, then, is a hint of changes in conditioning methods that will greatly lessen fuel consumption by obviating the necessity of heating air mass or building materials. Insulation needs will also be greatly reduced and year-round control brought down within reach of the most modest houseowner."

Franklin Endorsed Cool Air

On the evening of March 17 a public lecture was made on "Economies of Air Conditioning in Home and Business" by J. K. Knighton, manager of the air conditioning department of Nash-Kelvinator Corp. Mr. Knighton said that it was fitting that a discussion of this subject should take place in Philadelphia, since a series of talks on this subject had been given in 1866 in the Quaker City by Lewis W. Leeds when he spoke before the Franklin Institute, although at that time the term "air conditioning" was not used. Mr. Knighton quoted the following lines from a letter from Benjamin Franklin to Dr. Ingenhaus, physician to the Emperor at Vienna: "For some are as much afraid of cool clean air as persons in the hydrophobia are of fresh water. I myself had formerly this prejudice—this aerophobia, as I now call it—and dreading the supposed dangerous effects of cool air I considered it an enemy—experience has convinced me of my error; I even sleep with an open window. . . . You physicians have of late happily discovered after a contrary opinion had prevailed some ages, that fresh and cool air does good to persons with the smallpox and other fevers, and it is to be hoped that in another century or two we may all find out that it is not bad even for people in health."

Direct and Indirect Refrigeration

"What Do We Want In Air Conditioning?" was presented by J. R. Hertzler, manager air conditioning division, York Ice Machinery Corp., at the annual banquet and dance on the evening of March 18. In his talk Mr. Hertzler said: "Refrigeration can be applied by one of two methods, the direct method of refrigeration and the indirect method. In the direct method of refrigeration, the refrigerant gas itself can be supplied direct to cooling coils located in the path of the air stream, the evaporation of the liquid refrigerant within such air cooling coils producing the cooling effect required for cooling and dehumidifying the air supplied to the conditioned spaces. In the indirect method of refrigeration water would be cooled at a central point by the refrigeration apparatus and this chilled water would in turn be supplied to the air cooling device, being passed through cooling surface of the finned type or being sprayed direct into the path of the air stream, the air being cooled and dehumidified by intimate contact with the finely atomized water particles.

"The means of final heat rejection to the outside or the means of disposing of the heat removed from the conditioned space could be first, *water* or second, *air*. In the case of water cooled air conditioning systems, city water, if available at reasonable cost and in sufficient quantity, could be utilized to remove the heat from the space. Well water, also if available, could be utilized for the same purpose, the warm water being discharged into a sewer or outlet as provided. In the case of an air cooled system a cooling tower or a combined cooling tower and refrigerant condenser could be utilized. A certain small percentage of water from 1 to 10% of that required in a water cooled system would be utilized in order to improve the efficiency of heat removal of the use of outside air. Such outside air would need to be supplied to the cooling tower and removed from it in order to provide continuous economical operation of the air conditioning system.

Taxes Reduce Markets 25%

In an address on "Effects of Taxation and Legislation on Marketing," presented by F. Eldean, assistant to the president, American Petroleum Institute, before the morning session March 17, Mr. Eldean said: "Statistical data for 1936 indicate that the average domestic oil burner consumes 2016 gal. of fuel oil a year. A one cent tax would mean an increase in cost to the consumer of $20.16 annually. If both federal and state taxes are imposed, the increase in cost would be $40.32. That money could buy 16 barrels of heating oil. Taxes paid by three consumers would be equivalent to the amount of money that could be spent with your industry by a fourth customer.

"In the case of industrial oil burners, the 1936 statistics indicate consumption of about 500 bbl. per burner per year. A single tax would cost $210 per year, duplicating taxes $420. This sum would purchase 166 bbl. of fuel oil. Taxes paid by three consumers would be equivalent to the potential purchases of a fourth customer. Taxation which, at its inception and before rates are increased, reduces your market by one-fourth scarcely can be viewed as beneficial either to you, or to your customers."

Load Factors for Cooling and Dehumidifying Equipment Based on Field Tests

LOAD factor is a very useful conception. Especially in the electrical industry it has been put to use to good advantage in making estimates of cost or revenue and in determining the feasibility of projects of many kinds. It has not been very widely used in the heating industry. For that reason it is well to be sure that ideas of load factor are clear as it is often loosely applied to cover a variety of ideas.

Load factor expresses the ratio between the average use of a piece of equipment and its greatest possible use. Out of this general idea a number of corollary definitions have sprung. For instance, if we speak of the monthly load factor we mean the average load during the month divided by the load which the device would have carried if it had operated throughout the entire month at its maximum consumption. If we extend this idea further we can get a two-month load factor, a six-month load factor, a seasonal load factor,

1	2	3	4	5	6	7	8	9	10	11
City	Type of Building	Year Reported NR = Not Mentioned	Season YR = Year Round S = Summer W = Winter	Source of Figures A = Actual E = Estimated	Hours of Use				Load Factor for Cooling and Dehumidifying	
					Hours Plant Operated	Hours Use of Maximum Demand			Summer (5 Mo.) Basis	Annual Basis
						Compressor	Fan	Cooling and Dehumidifying		
Birmingham, Ala. .	Department store ...	NR	S	E		1200	1200	1200	0.326	0.137
	General office	NR	S	E		1000				
	Residence	NR	S	E		1200				
	Restaurant	NR	S	E		1050	1050	1050	0.386	0.162
Gadsden, Ala.	Drug store	1935	S	A		1160	1500			
Montgomery, Ala. .	Hotel coffee shop ...	1935	S	A				1640	0.446	0.187
	Theater	1935	S	A				1250	0.340	0.143
Washington, D. C..	5c and 10c store....	1935	S	A				1400	0.381	0.160
	Restaurant	1935	S	A				1100	0.30	0.126
	Restaurant	1935	S	A				1350	0.367	0.154
	Hotel dining room..	1935	S	A				1500	0.408	0.171
	Drug store	1935	S	A				1750	0.475	0.199
	Drug store	1935	S	A				1450	0.394	0.165
	Drug store	1935	S	A				1850	0.504	0.212
	Small store	1935	S	A				900	0.245	0.103
	Small store	1935	S	A				700	0.191	0.08
	Large store	1935	S	A				1750	0.475	0.199
	Funeral parlor	1935	S	A				350	0.095	0.040
Joliet, Ill.	Department store ...	1935	S	A				652	0.178	0.075
Evansville, Ind. ..	Industrial office	1935	S	E				600	0.163	0.068
	Electrical appl. store	1935	S	E				1500	0.408	0.171
New Orleans, La. .	General office	1935	S	E	1180					
	Complete office bldg.	1935	S	A	1276					
	Large store	1935	S	A	3036					
	Residence	1935	S		745					
	Small restaurant ...	1935	S	E	2400					
	Specialty shop	1935	S	E	1400					
	Printing plant	1935	S	E	800					
	Undertaking est. ...	1935	S	A	1460					
Baltimore, Md. ...	Theater	1935	S	A		546				
	Theater	1935	S	A		1582				
	Theater	1935	S	A		710				
Boston, Mass.	Store	1935	YR	A				924	0.251	0.105
	Restaurant	1935	YR	A				1161	0.316	0.133
	Restaurant	1935	S	A				423	0.115	0.048
	Restaurant	1935	YR	A				926	0.251	0.105
St. Louis, Mo. ...	Residence	1935	S		364					
	Residence	1935	S		333					
	Residence	1935	S		179					
	Residence	1935			950					
	Residence	1935			606					
Brooklyn, N. Y. ..	Department store ...	1935	S	E				1000	0.272	0.114
New York, N. Y...	Tavern	1935	S	A		740				
	Salesroom and office.	1935	YR	A	2302	708		1241	0.338	0.142
	Bank	1935			446					
	Theater	1935	YR	A		700		810	0.221	0.092
	Store	1935	S	E		880				
Rochester, N. Y...	Executive offices ...	1935	S	E				640	0.174	0.073
	Hotel tap room	NR	S	E				1780	0.485	0.204
Cincinnati, O.	Office building	1935	S	A		667	635	1000	0.272	0.114
	Department store ...	1935	S	A	1100			680	0.185	0.077
	Women's dress shop.	NR	S					635	0.173	0.073
Muskegon, Okla. ..	Restaurant	1935	S	E		1430		1700	0.462	0.193
Oklahoma City, Okla.	Cafeteria	1935	S	A				640	0.174	0.073
	Jewelry store	1935	S	A				759	0.207	0.085
	Office bldg.	1935	YR	A				1211	0.330	0.138
Philadelphia, Pa. .	Private office	NR	YR					990	0.270	0.113
Pittsburgh, Pa. ...	Salesroom	1935	S	A	1620	610	1610	750	0.220	0.092

or an annual load factor. These are all essentially alike except that the factor is measured over different fractions of the year.

As the ordinary refrigeration compressor operates in air conditioning work, it seldom operates at all during the winter months and may operate almost continuously during certain periods in the summer. The same general statement is true of many other pieces of equipment such as fans, motors, pumps, oil burners. Briefly, any intermittently operating device has a load factor.

If we take this load factor thought and apply it to heating or cooling equipment the monthly load factor of an electric refrigeration compressor, let us say, would be the average electric consumption of the machine during the month divided by the consumption which the machine would use if it operated at its peak demand throughout every one of the hours of the whole month. If we were to apply this same idea to the annual load factor of the same refrigeration compressor we would take the average annual consumption and divide it by the consumption which the machine would use operating at its peak throughout the entire year.

Load factor can also be found by a rather roundabout procedure where data are not at hand to compute directly. This consists of finding the "hours use of the maximum demand" by dividing the energy consumption over a period of hours by the maximum hourly demand observed during this period, and then dividing this number by the total number of hours during the period. This method may be applied where the energy consumption over a period and the corresponding maximum hourly demand are known.

Until recently there has been but little data publicly available to permit computing the load factors of refrigerating compressors, pumps, fans, and similar equipment when operating normally under practical surroundings in air conditioning. In late years, however, many electric utility companies have put meters on such installations and have collected enough information to permit calculations to be made. In other cases they have used consumption meters and estimated the demands. Results have been reported to a committee of Edison Electric Institute and appeared in Publication D 12 of the Institute. Some of the load factors from installations in widely scattered cities are shown in the accompanying table, which has been computed from cases reported in that publication.

Cases included in the table comprise only those where the reported data permit computing the hours use of the maximum demand with reasonable results. Also in selecting the cases to be tabulated preference was shown for those where the report showed that meters were actually used.

From the table it will be noted that over half the reported cases are stated to be based on actually metered jobs, that many of them show the results over the summer period only and that most are for the year 1935. It was also not possible to include full results in the hours use of the maximum demand in columns 7, 8, and 9 because in most cases separate meters were not applied to each of the pieces of equipment. Column 9, which contains the most figures, was obtained by dividing the electric consumption of compressors, fans, pumps, and auxiliaries as a group by the maximum hourly demand of the whole group.

It should also be noted that in only a few cases are both the hours of actual operation and the hours use of the maximum demand reported. In the few cases where both figures are shown the ratio is about 0.55 average and varies from 0.47 to 0.62. This would lead to the thought that the actual hours of operation of the whole air conditioning plant (column 6) are generally about double those shown in column 9. Column 10 is obtained by dividing column 9 by 3672, the number of hours in the period from May 1 to September 30, inclusive. Column 11 is obtained by dividing column 9 by 8760, the number of hours in a full year. Values of the load factor for the compressor and fan for these same periods can be obtained in like manner by using the figures in columns 7 and 8, respectively.

Several points should be kept in mind in using these load factor values. For one thing, they are early figures and may be revised. For another, there is a lack of uniformity about the reports from which they are drawn. Also they are for one season only and the nature of the season affects the load factor value. From the records of temperature available it appears that the cooling season of 1935 was less severe in most localities than "normal," although there is still a lack of information as to where the normal really lies. Because of this the load factors shown in the table can be expected to be smaller than may be found in many seasons.

EDITORIALS

A New Warm Air Heating Code

In this issue we print in full the technical code on forced warm air heating recently issued by a committee of the National Warm Air Heating and Air Conditioning Association. It is likely that this code will be widely used as have the previous ones on this general subject issued by this association. This one systematizes the method of sizing ducts and uses the friction head method of proportioning them. It also outlines a step-by-step procedure for applying the data to duct design. It is specifically stated that the intent of the code is to protect the buying public and that its field of use is limited to buildings of not more than three stories or having a heat loss at winter design conditions of more than 250,000 B.t.u. In other words, it is aimed at forced warm air installations of the kind where there is all too frequently no engineer to represent the owner's interest directly and where the principal technical protection that he gets has to come from engineers employed by others. The very fact that manufacturers will spend the time and effort necessary to draw up rules to try to protect the purchaser of their equipment shows that they realize how important it is in the long run that every installation have a reasonable chance to work well. On the part of some engineers there is a tendency to belittle codes of this kind but we see no justification for such a feeling. It is true that they tend to limit initiative but in some cases initiative can be limited to good advantage. At their worst, codes can become positively oppressive but a close reading of this code does not disclose anything which unduly restricts anyone. Moreover, it is a voluntary code, appears to have been drawn up with care, and frankly states that it is not suitable for solving unusual problems. In such cases special engineering advice should be sought.

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Increasing Importance of Water

We have long held a personal opinion that water and its use in connection with summer air conditioning would eventually come to be recognized as a most important factor. For a long time we found but few people to agree with this opinion. To altogether too many the important consideration seemed to be the source of power and the kind of refrigerant to be used. The water question is more fundamental. The water receives and carries away the heat quantity. Without proper use of the water, operating expenses may become excessive. Without enough water many plants now installed cannot operate. Without water of high enough quality there are serious operating troubles. Within the past year there has been an awakening of interest in the water problem in most of its aspects and it now appears to be receiving the attention which its importance demands. Improved spraying devices are appearing, the evaporative condenser is coming into its own, cooling towers are now in general use, and there is an awakened interest in deep well water. As a corollary to the water problem the possibilities of air cooled condensers are also being reweighed and re-examined. As another corollary of the summer water problems the winter use of water for heating is also now receiving an emphasis which was lacking before the summer application was as generally understood as it is now.

Industrial Ventilation Progresses

For some months we have given continuing attention to the revival of interest in industrial ventilation which has been going on. Further evidences of this have come to light during the past month. The American Foundrymen's Association has published a code covering recommendations for grinding, polishing and buffing equipment sanitation. The code on exhaust ventilation fundamentals prepared by American Standards Association has made its appearance. An English translation of a Russian book listing some of the maximum concentrations of dangerous gases in industrial air permitted in Russian practice has appeared. This same book also shows the concentration of these gases found to be present in various workshops in Russia. Here is a considerable grist of data for the engineer's mill. All of this material shows the growing tendency to get at the really fundamental requirements and to depart from empirical rules of practice as fast as possible. In the case of industrial ventilation there is still a long road ahead but the adoption of an analytical method of approach is especially gratifying.

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The Conference Season

This month sees the continuation of what are coming to be annual spring conferences or short courses at a number of the leading educational institutions. Beginning with the one held at Michigan State College on March 29 to April 1, the season continues with those at Iowa State College on April 7 to 9, and at Wisconsin on April 21 to 23, and closes with the Illinois meeting on May 25 to 27. These conferences will attract a total attendance running into the thousands. Their effects on the industry are wholesome and their programs show a wide scope of subjects to be discussed. We have always been glad to lend active aid and support to them and again urge all who can do so to plan attending at least one of them. The younger men especially will find them valuable and inspiring.

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The Schoolhouse Disaster

The Texas schoolhouse disaster came as a great shock to everyone but especially to those who are connected with school heating in any form because of the press implication that the heating system may have been the cause. We make no pretense of knowing to what extent, if any, the heating system was really to blame but there is a spectacular lesson in this situation for all of us. It brings home forcefully the fact that regulations governing the installation of heating equipment in schools are not unnecessary and evil. They may be poorly drawn in some localities and they may be arbitrary. In some cases they may work a hardship on certain methods and certain kinds of equipment but few people would advocate a situation where there is no regulation. Too much is at stake to take risks with children's lives.

WHAT READERS SAY • • •

Sun Heat Gains

With reference to HEATING & VENTILATING's Reference Data (79-80), (83-84), (85-86), I would appreciate it if you will answer the following questions:

Question 1: In order to determine the total heat gain from a vertical wall facing the sun, is it necessary
first to estimate sun heat, $H_s = AIbg$
second to estimate transmitted heat, $H = AU(t_i - t_o)$
and then add both together $H_s + H$ = total heat gained
or, does the formula $H_s = AIbg$ equal the total heat gain of a wall facing the sun?

Question 2: Will you give me an example of the proper procedure by working out these two typical problems? What is total heat gain due to these walls?

(a) 100 sq. ft. 16-in. vertical common red brick wall facing northwest on a sunny day; 40° north latitude; U value = .25; temperature outside 95F, inside 80F; time of day is 5 p.m.

(b) Same as part (a) except at 1 p.m.

Question 3: In order to determine the total heat gain from a vertical plain single glass window facing the sun, is it necessary
first to estimate sun heat, $H_g = ASI_g$
second to estimate transmitted heat, $H = AU(t_i - t_o)$
and then add both together $H_g + H$ = total heat gained
or, does the formula $H_g = ASI_g$ equal the total heat gain due to the glass facing the sun?

Question 4: Will you give me an example of the proper procedure by working out these two typical problems What is the total heat gain due to these windows:

(a) 100 sq. ft. of vertical plain single glass window facing northwest on a sunny day. Inside shades, light colored, fully drawn; 40° north latitude; U value = 1.24; temperature outside 95F, inside 80F; time of day 5 p.m.

(b) Same as part (a) except at 1 p.m.

CHICAGO, ILL. F. E.

Question 1: It is necessary first to estimate sun heat by the formula $H_s = AIbg$ and use data sheets 83-84 and 85-86. Then estimate the transmitted heat by $H = AU(t_i - t_o)$. Add these together, and obtain their sum as the total heat added through the surface in question.

Question 2: (a) First, estimate the transmitted heat as:

$H = 100 \times 0.25\ (95\text{-}80) = 675$ B.t.u.

Then, estimate the sun heat in the brick wall as:

$H_s = 100 \times 143 \times 0.55 \times 0.05 = 393$ B.t.u.

Total = H plus H_s = 675 plus 393 = 1068 B.t.u. per hr.

(b) Estimate transmitted heat as in (a)

$H = 675$ B.t.u.

Then estimate sun heat as:

$H_s = 100 \times 6 \times 0.55 \times 0.05 = 16.5$ B.t.u.

Total = H plus H_s = 675 plus 16.5 = 691 B.t.u. per hr.

Question 3: It is necessary first to estimate the sun heat by the formula $H_g = ASI_g$. Then estimate the transmitted heat by $H = AU(t_i - t_o)$. Add the two together.

Question 4: (a) Estimate transmitted heat as:

$H = 100 \times 1.24\ (95\text{-}80) = 1860$ B.t.u.

Estimate sun heat as:

$H_g = 100 \times 130 \times 0.50 = 6500$ B.t.u.

Total = 1860 plus 6500 = 8360 B.t.u. per hr.

(b) Estimate transmitted heat as in (a)

$H = 1860 =$ B.t.u.

Estimate sun heat as:

$100 \times 0 \times 0.50 = 0$ B.t.u.

Total = 1860 plus 0 = 1860 B.t.u. per hr.

The above outline gives the correct *method*, but be sure to note that the sun heat estimate presupposes that the area in question is actually exposed to the direct rays of the sun. By 5 p.m. the sun is usually lower and its rays may be cut off the surface by surrounding objects.

●

Room Temperature

Please give me a formula for determining the temperature to which a room will be heated when the following are given:

Heat loss from room 300 B.t.u. for 1F difference in temperature between indoors and outdoors.
Heating surface 53.2 lin. ft. 2½-in. steam main (uncovered).
Steam at 1 lb. pressure.

My reason for asking this question is because of the variation of K as the temperature difference changes.

Springfield, Ill. M. J. B.

A formula for determining the temperature to which a room will be heated when the heat loss of the room and the amount of heating surface is given is as follows:

$$t_i = \frac{KNt_p + Ht_o}{KN + H}$$

K = Emissivity of pipe
t_i = temperature of room
N = Heating surface in square feet
H = Heat loss of room
t_p = temperature of pipe
t_o = outside temperature

For a 2½-in. bare iron or steel pipe the values of K for various temperature differentials are as follows:

Temperature Diff.	100F	120F	140F	160F	180F	200F
K	2.3	2.37	2.45	2.55	2.65	2.75

When utilizing this formula it is first necessary to select a trial room temperature so that a value may be substituted for K. The formula is then solved for t_i, the room temperature. Using this room temperature a new value of K is selected and the formula is again solved for the room temperature. If this answer differs greatly from the previous answer the formula must be resolved using a revised value of K.

An example follows:

Steam temperature 215F, outside temperature 0F, heating pipe surface, 53.2 lin. ft. of 2½-in. pipe, or 40 sq. ft.

First trial solution:

Assume that the room temperature is 50F, the temperature difference is then 215F-50F or 165F.
Interpolating from the tables, value of K, $K = 2.58$

$$T_i = \frac{2.58 \times 215\text{F} \times 40 \text{ sq. ft.} + 0 \times 300 \text{ B.t.u.}}{2.58 \times 40 + 300 \text{ B.t.u.}} =$$

$$\frac{22188}{103.2 + 300} = 55\text{F}$$

Second trial solution:

Using the above room temperature,
Temperature difference 215F − 55F = 160F and the value of $K = 2.55$

$$t_1 = \frac{2.55 \times 2.5 \times 40 + 0 \times 300}{2.55 \times 40 + 300} = 54.6F$$

Since for (215 — 54.5) or 160.4F temperature difference, the value of K is the same as in the second trial solution, the answer is 54.6F.

●

Degree-Day in Schools

As a means of stimulating a real interest among our engineers and firemen in the more economical use of coal for heating our schools as against the old worn out and oft repeated phrase of "cut expenses" which was heard so much during our recent depression, an attempt is being made this year to introduce the degree-day method of comparing costs, coal consumption records, temperature records, etc., as a means of more intelligently operating our school heating plants. Our efforts have been well received by engineers and firemen. An explanation of what the degree-day method is and the results we hoped to attain by it were described at a group meeting; all expressed an interest and willingness to "do the best we can."

To illustrate our endeavor of this year we will cite our Senior High School as the example, for it has a large heating plant, serving not only the High School and its Annex, but also the South Junior High School a block distant. This heating plant consists of three 350-hp. boilers, two of which can carry the full load, the third being held in reserve for emergency.

Records of the maximum, minimum, and average daily air temperatures for the school year (1935-36) have been made, so that daily comparisons can be made with corresponding days in the present school year (1936-37). From these daily air temperature records monthly tables have been made showing for each month the daily average air temperature and its corresponding number of degree-days for last year and comparing it with the corresponding data for this year.

Daily records of the quantity or weight of coal burned are kept by the engineer operating the boiler plant and entered on report forms which in turn are sent in to one central office at the end of each week. This information is then entered on another form so as to make direct comparisons with coal consumption a year ago on the respective days.

An attempt has been made to prepare a chart similar to Chart A as proposed by R. E. Hieronymus in a recent issue of HEATING & VENTILATING so that a more accurate determination of the amount of coal *actually required* per degree-day could be determined. However, we have not as yet been able to theoretically determine the steam required for a zero day due to the fact that these buildings in 24 hours house so many different programs in addition to school classes, viz: swimming pools, cafeteria, auditorium used by outside organizations, gymnasiums used for basketball games, and WPA recreation programs, showers, etc., that require the burning of coal. We will, however, develop this chart later from records now in the making. A varied form of chart is in use, however, using as the "Zero Day" quantity the amount of coal burned last year on a zero day. This, of course, may or may not be the correct amount but nevertheless it gives us a means of comparing this year's operation with last year's.

At the end of each week the central office computes the amount of coal burned, compares it with the corresponding week of the year previous, and then a letter to the engineer is written giving him all the data, including corresponding temperatures, degree-days, etc., and advising him of either the increase or the decrease in his coal consumption for that particular period, with a request that he explain how either was accomplished. This same procedure follows at the end of each month when the totals for the month are arrived at.

Although this effort has been made for only the past three months, the results obtained to date are very interesting and are given herewith for four of our schools.

Month	Tons of Coal Burned 1935	1936	Tons of Coal 1936 vs. 1935
High School			
September	75.50	45.45	—30.05
October	151.75	112.05	—39.70
November	*227.00*	*214.35*	—*12.65*
Three Months' Total	454.25	371.85	—82.40
North Junior			
September	50.40	23.88	—26.62
October	86.60	76.75	— 9.85
November	*125.75*	*139.00*	+*13.25*
Three Months' Total	262.75	239.63	—23.12
Gaskill Junior			
September	41.90	23.55	—18.35
October	67.05	56.20	—10.85
November	*92.80*	*98.40*	+ *5.60*
Three Months' Total	201.75	178.15	—23.60
Trott Vocational			
September	13.00	13.50	+ 0.5
October	38.82	36.87	— 1.95
November	*63.11*	*77.86*	+*14.75*
Three Months' Total	114.93	128.23	+13.30

In order to have a means of comparing the various coal consumptions with the corresponding average air temperatures, we prepared the following table:

Month	1935 Average Air Temp.	1935 Degree-Days	1936 Average Air Temp.	1936 Degree-Days
September	58	197	63	138
October	49	470	42	498
November	*40*	*770*	*33*	*967*
	Average 49	Total 1437	Average 46	Total 1600

It is interesting to note from the above that of the four schools cited, three of them have burned less coal in September, October, and November of this year as compared with the same months of last year, in spite of the fact that the average air temperature was three degrees colder and the number of degree-days 163 greater.

It is also interesting to note that in the month of November while all the rest of the schools burned more coal this year, the High School alone burned less. This may be accounted for as follows:

1. The boiler meters have been installed and the boiler attendants are much more alert in regard to firing.
2. Boiler 2, which has the old horizontal baffles and is therefore less efficient than boilers 1 and 3, has not been used at all this year but has been held in reserve for emergency. Last year this boiler was operated during the early part of the heating season.
3. This year the valves in one of the vacuum pumps were renewed so that there is a 5 or 6 in. vacuum on the heating system. Last year there was no vacuum.

W. T. Schepeler, Engineer
of Construction and Maintenance.
Board of Education,
City of Niagara Falls,
New York.

●

Heat Emission

What is the difference between the total heat output of an adult when at rest as compared with a man walking?

Astoria, L. I. G. P. M.

An average person seated at rest has a total heat dissipation of approximately 385 B.t.u. per hr., whereas a man walking three miles per hour dissipates 1050 B t.u. per hr.

ABSTRACTS of Current Papers, Books and Pamphlets

Design and Operation of Exhaust Systems

The purpose of this report is to present the basic engineering principles of the design and operation of exhaust systems to minimize exposure to poisonous dusts, gases, and fumes. The report was presented at the recent National Conference on Silicosis in Washington, by the engineering committee of the conference. In this present report an attempt is made to assemble the fundamental data available at the present time and to indicate the manner in which these influence the method of design. The committee is careful to point out, however, that the report is incomplete and that a great deal of critical analysis of exhaust systems is necessary to build up a body of technical experience to serve as a guide for future design. Among the subjects taken up are the layout of industrial plants to minimize the danger from dusts, fumes and gases; the design and installation of exhaust gases; exhaust piping; air cleaning plants; size and selection of exhaust fans; and the constructions and maintenance of exhaust systems in general.

[*"Fundamentals Relating to the Design and Operation of Exhaust Systems," ASA-Z9, preliminary edition, 1936. Published by the American Standards Association, 29 W. 39 St., New York. Paper cover; 8½ x 11 in.; 27 pages; price, 40c.*]

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Pape-Swift Boiler Reference Book

The 1937 edition of the Pape-Swift Boiler Reference Book lists specifications of many new and old boilers. As it is a practice of the author of these books in preparing new editions to include only boilers not listed in previous volumes, the series of four books offers a quick and ready reference for determining the rating of a large percentage of the boilers now in use. The present edition lists the boilers of 33 manufacturers while the series contains information from over 80 companies.

A new feature of the book is the use of photographs and line drawings to illustrate the new boilers which have been placed on the market during the past year. A Master Index which is the working key to all four volumes is included with each book or the series. This index greatly simplifies the location of information on any particular boiler as it is only necessary to refer to the index to find in which book the boiler is listed.

[*"Pape-Swift Boiler Reference Book-1937." Compiled by Oscar H. Pape and published by John S. Swift Co., Inc., 105 S. Ninth St., St. Louis, Mo. Paper cover; 5½ x 8½ in.; 333 pages; price, $1.10, including postage. One Master Index free with each order. Others, 25 cents.*]

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Big Business — Its Growth and Its Place

This book is the first of three volumes embodying the results of a study of big corporations and their place in American life. Two succeeding volumes will be entitled "How Profitable is Big Business?" and "Big Business Salaries."

This first volume attempts to show how large big business bulks in comparison with the smaller concerns on the American economic map as a whole, and on the various sectors of the map which represent specific industries and groups of industries. It shows, for example, that individuals and partnerships still carry on almost half of the country's total business. Only 57% of economic activity is incorporated at all and the proportion that corporations do of total business varies greatly from one industry to another.

While half of the business of the country is done by unincorporated enterprises, and while there are vast numbers of corporations that cannot be called "big" under any definition, it is likewise true that the giant corporations are very big indeed. The 594 largest corporations, which are three-twentieths of 1% of the total number of corporations, owned 53% of the total corporate assets in 1933. Distribution of net income of the largest corporations shows the same high degree of concentration.

[*"Big Business—Its Growth and Its Place," prepared under the auspices of the Corporation Survey Committee of the Twentieth Century Fund, Inc., and published by the Fund at 330 W. 42nd St., New York. Size 5½ x 8¼ in.; cloth-bound; 102 pages; price, $1.35.*]

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1937 ASHVE Guide

A number of changes have been incorporated in the 15th edition of the American Society of Heating and Ventilating Engineers Guide. These changes include the recalculation of tables and charts utilizing the latest fundamental data, the rewriting of chapters and sections of chapters to bring the material up to date, and inclusion of new chapters.

Tabular data giving the properties of dry and saturated air have been recalculated and based on the instantaneous specific heats of air. A new table has been compiled giving the true, mean and instantaneous specific heats of air over a wide range of temperatures based on data given in the International Critical Tables.

The material on the physical and physiological principles of air conditioning has been completely rewritten with special emphasis placed on the fundamental requirements which must be considered to properly design a system for comfort. The introduction of new building materials and insulations has necessitated the enlargement of the tables of heat transmission coefficients and in addition the text included in this chapter has been rewritten and condensed with revised arrangements of fundamental formulas.

A new chapter has been added on humidification, dehumidification, and water cooling equipment. Included in this chapter are design tables and curves for the design of natural and mechanical draft cooling towers. Another new chapter takes up the subject of automatic control and discusses the several types of controls available for residential, commercial, and industrial applications. A new chapter on sound control has been prepared to present the subject material in a manner more suitable for interpretation by the heating and air conditioning engineer. A method is outlined for determining the proper amount of sound absorbent material to apply to a duct system. The fourth new chapter, entitled "Air Distribution," gives information on air diffusion technique within enclosed spaces. Standards are outlined for the maintenance of satisfactory comfort conditions during both summer and winter. Air outlet noises are discussed in detail with charts and illustrated examples to indicate the method of grille or outlet selection. The chapter on drying systems has been improved by the addition of several new charts and tables applicable to varied systems of drier installations. Among other chapters which have been revised are those of refrigeration, cooling methods, air cleaning devices, boilers, steam heating systems, hot water heating systems and electric motors and controls. A new Bulkely psychrometric chart with an additional directrix line has been inserted in an envelope attached to the inside back cover. In all there are 44 chapters of 808 pages in the technical data section.

[*"ASHVE Guide, 1937." Published by the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York. Flexible binding; 6 x 9 in.; 1200 pages; price, $5.*]

Pumps and Hydraulic Standards

Since 1921 the Hydraulic Institute, a trade association of pump manufacturers, has been collecting and compiling engineering data on pumps and hydraulics for engineers, buyers and users of pumps. The pamphlet is now in its seventh edition, having grown from 16 pages to over 150 pages.

The booklet is divided into seven sections entitled as follows: General Section; Centrifugal Pumps; Rotary Pumps; Reciprocating Pumps; Deep Well Turbine Pumps; Test Codes; and Data. For the convenience of those who may not be interested in the entire volume, the various sections may be ordered separately.

Included in the subjects discussed by the pamphlet, which are of interest to heating and air conditioning engineers, are recommendations of materials to be used in pumps handling various liquids, instructions for installing and operating different types of pumps, charts for figuring friction of fluids in pipe line, specific pump speed curves, pressure temperature curves for pumping hot water, and a chart showing the resistance of valves and fittings to the flow of fluids.

[*"Standards of Hydraulic Institute," published by Hydraulic Institute, 90 West St., New York. Loose-leaf binding; 8½ x 11 in.; approximately 158 pages; price, $1.*]

●

Air Conditioning Insulation

The purpose of this book is to teach the principles and applications of insulation in all of its most common forms and uses. Among the types of insulation discussed are those for (1) retarding heat losses and gains through structural parts of buildings; (2) preventing loss by fire; (3) controlling sound; (4) preventing vibration; (5) protecting buildings against termites; (6) protecting all mechanical parts against heat losses and freezing; and (7) preventing condensation.

The authors assume that the reader is familiar with simple mathematics, architectural details, design of ducts and general heating and air conditioning principles. All principles and methods of design or calculation are typical and when more than one generally accepted method is used in actual practice, both methods are illustrated.

A good idea of the contents of the book may be obtained from the following list of chapter headings: Physics of Insulation; Kinds of Insulation; Where Insulation is Used; Heat Transmission Coefficients and Tables; Heating and Cooling Loads; Tables and Coefficients; and Design of Insulation. A psychrometric chart has been inserted in the rear of the book.

[*"Air Conditioning—Insulation," by J. Ralph Dalzell and James McKinney. Published by the American Technical Society, Chicago. Cloth binding; 6 x 9 in.; 301 pages; price, $2.50.*]

●

Markets for Heating Equipment in American Homes

That there exists a large potential market in urban cities for the installation of heating facilities in homes is indicated in a study just made public by the Marketing Research Division of the Bureau of Foreign and Domestic Commerce. The basic data included in the study were collected as a part of the Real Property Inventory taken in 1934.

The study shows that stoves occupy a prominent place as a heating device for single-family and for two-family structures in all regions of the United States, the statistics evidencing that more than two-fifths of the structures reported upon were equipped with heating stoves.

The utilization of heating stoves is more apparent in the southern, mountain, and Pacific Coast cities where the climate is less severe. Approximately nine-tenths of the structures in the west south central cities depend on stoves for heating purposes. About two-thirds of the residential houses reported on in the mountain area utilize heating stoves. Next to the heating stove, the warm-air furnace is the most commonly used heating system.

Approximately 66% of the 1,931,055 structures included in the study reported the use of coal as the principal fuel for heating. While the use of coal predominates in seven of the nine geographical divisions, the importance varies sectionally. The middle Atlantic and east north central cities rank highest in the matter of the use of coal with approximately 93% of the structures in each area utilizing such fuel for heating.

Wood as fuel for heating is most commonly used in Pacific Coast cities where over one-half of the structures reported upon use of wood. The west south central and south Atlantic divisions follow in the order named. Except in a few small cities, the use of wood as fuel is relatively insignificant in most of the other geographical areas. Only 0.3% of all structures in the urban communities were reported as without heating apparatus of any kind.

The study which has just been made available is one of a series of similar marketing reports prepared by the Department of Commerce and designed to give to the appropriate trades pertinent information on urban residential dwellings and to help American business firms engaged in the distribution of sanitary plumbing and heating equipment and related household appliances to determine, as accurately as possible, potential markets or sales possibilities for their goods.

[*"Markets for Plumbing and Heating Facilities in Residences," Market Research Series No. 12, by S. L. Kedzierski. Published by the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington; 8 x 10¼ in.; 156 pages; price, 10 cents.*]

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BRIEF REVIEWS

CONTRACTORS CODE. A voluntary code of fair competition for the heating, piping and air conditioning industry in the city of New York and the counties of Nassau and Suffolk in the state of New York. The purpose of this code is to eliminate unfair practice now prevalent in the industry which has resulted in the lowering of wage scales, wage kick-backs, the use of improper substitutes for standard or specified materials and the submission of bids for work and materials at prices below actual cost. Code has been adopted by the Enterprise Association, Local Union 638, and the Progress Association, Local Union 639, of the United Association of Plumbers and Steamfitters of the United States and Canada and the Heating, Piping and Air Conditioning Contractors New York City Association, Inc. [*"Voluntary Code of Fair Competition for the Heating, Piping and Air Conditioning Industry," published by the Heating, Piping and Air Conditioning Contractors New York City Association, 1945 Grand Central Terminal, New York. Paper cover; 4½ x 6 in.; 27 pages.*]

COAL SELECTION—A classification of the various factors which should be taken into consideration in determining the value of coal for any particular use. [*"Factors Recommended for Consideration in the Selection of Coal." A report to the Technical Committee on the Classification of Coal. Published by the National Committee on Coal of the National Association of Purchasing Agents, 11 Park Place, New York. Paper cover; 8½ x 11 in.; 21 pages.*]

WARM AIR CODE. A code formulated to provide reliable methods of design and installation of mechanical warm air heating systems. A very complete abstract of this code appears on page 44 of this issue. [*"Technical Code for the Design and Installation of Mechanical Warm Air Heating Systems." Published by the National Warm Air Heating and Air Conditioning Association, 50 West Broad St., Columbus, Ohio. Paper cover; 8½ x 11 in.; 36 pages; price, 50c.*]

NEWS OF THE MONTH

Expects Big Farm Modernizing Market

NEW YORK—Long neglected depreciation of farm homes and buildings has piled up a need for $665 million worth of repair, replacement, and modernization annually for the next 30 years if the national farm plant is to be maintained in workable shape, according to P. A. Andrews, Johns-Manville vice-president in charge of building materials.

He also predicts an extensive revival of rural construction during 1937, basing his forecast on the additional facts that there are more farmers in the United States today than at any previous time in history, that the number of farms increased 9% between 1930 and 1935, that a larger proportion of the farm population is staying at home than in the pre-depression era, and that agricultural income is expected to be at least as great this year as in 1936 or 1935.

Mr. Andrews believes that during 1937 the greatest volume of rural building activity will be repair and modernization rather than new construction. Of the $665 million which farmers of the United States should spend annually for the next 30 years on replacement, the maintenance of non-home structures—barns, sheds, mills, silos, etc.—would account for $317 million; replacement and upkeep of dwellings $280 million, and modernization of both types of structures $68 million.

As to farm dwellings, the total value in 1930 was shown to be $7 billion. Economic and statistical evidence indicates that the average existing farm home has only a maximum of 50 more years of life if properly repaired and maintained. This runs the bill for replacement of farm houses to $140 million a year and assuming 2% for repairs and maintenance, an additional $140 million a year is needed. This gives a total of $280 million required for farm homes alone.

Propose New ASHVE Chapter

BIRMINGHAM, ALA.—Tentative plans for the establishment of a Birmingham unit of the ASHVE were made at a meeting March 22, attended by A. V. Hutchinson, national secretary of the organization.

Arrangements for the meeting were made by Harold V. Fried, Birmingham Electric Co. engineer, and C. P. Lichty, Lichty Engineering Co. Officers will be elected at a later meeting.

Iowa A. C. Conference

AMES, IOWA—The second Iowa Heating and Air Conditioning Conference is to be held at Iowa State College here April 7-9. The purpose of the Conference is to bring the latest educational and informational material on heating and air conditioning to Iowa contractors, coal stoker and oil burner dealers, plumbers, architects, and the public.

Topics to be discussed include: developments in heating; economical design of a warm-air heating system; radiator heating of the future; developments in humidification, air cleaning, air washing; heat losses and efficiencies of fuels in residence heating; how to operate an oil-fired heating plant efficiently; use of Iowa coal in residential stokers; servicing and maintenance of a coal stoker; automatic controls—improvements and problems; cooling requirements for summer comfort; cooling without refrigeration; summer air conditioning for residences; technical problems of air conditioning; future of air conditioning.

An exhibit of heating and air conditioning equipment and accessories is planned. Further information can be obtained from Lindon J. Murphy, engineer in charge.

Lewis Addresses Theater Owners

MIAMI—Theater air conditioning systems will pay for themselves in five years with only a 4% patronage increase, L. L. Lewis, chief engineer of Carrier Corporation, told the Motion Picture Theater Owners Association at its annual convention, March 15-19.

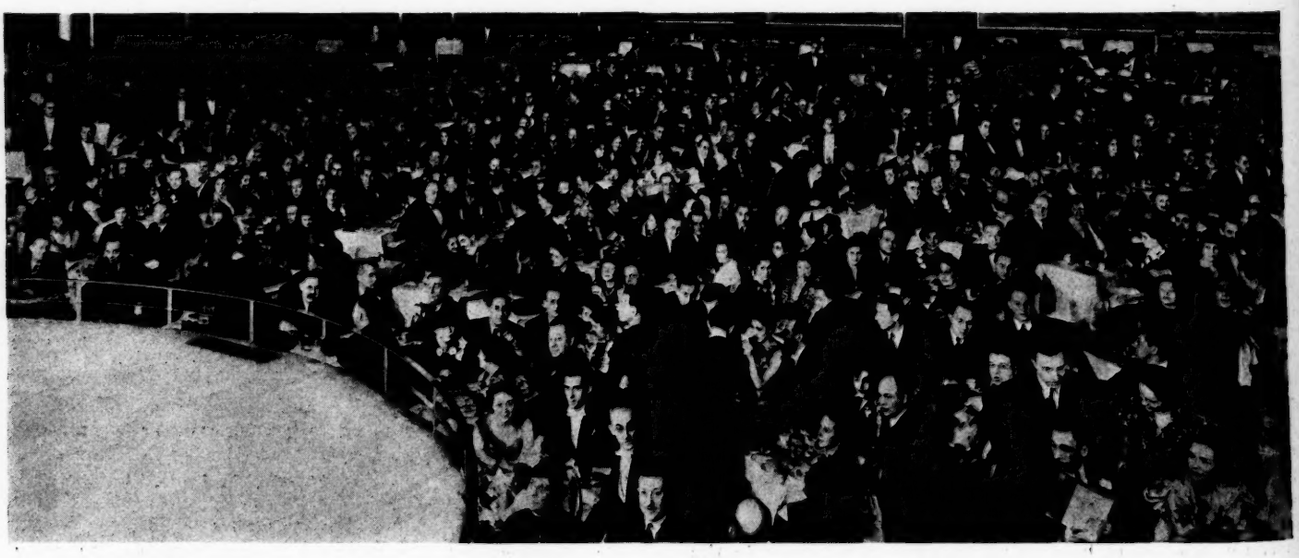
Mr. Lewis said theater owners should figure air conditioning as a long-term investment to be paid off through annual charges.

"The experience of many exhibitors has proven positively that a good showman can invest in air conditioning and make it pay out 100% in a very few years," he explained.

"With this as a proven possibility and considering that show business is a fast moving, quick changing business, five years has been selected as the longest time in which a system should liquidate itself 100%."

Stressing the fact that air conditioning ended the summer slump and the necessity for the resulting fall buildup, Mr. Lewis said:

"But there is so much heat coming from warm seats and lights that the house needs cooling when it is still too cold outdoors to need the refrigerating machine. The exhibitor who does not buy winter conditioning for the extra 10% runs the chance of losing patrons he has gained during the summer and that may cost him a lot of dividends on his system."



With over 600 in attendance, the third annual supper-dance and follies show of The Association of Heating Contractors of Greater New York occupied the whole ground floor of the French Casino for the midnight show on March 3.

Contractors Announce Convention Program

NEW YORK—The program for the 48th annual convention of the Heating, Piping and Air Conditioning Contractors National Association, to be held in Minneapolis May 17-19, has been released, although the program is still in somewhat preliminary form. All of the sessions will be held in the Hotel Nicollet.

Omitting a number of details the program follows:

MAY 17

2 p.m.

Welcome Address, Mayor of Minneapolis.
President's Address, John H. Zink.
Report of Secretary, Joseph C. Fitts.
Report of Educational Department, S. Lewis Land, educational director.

MAY 18

9:30 a.m.

Report of Membership Committee, M. J. Chagnard, general chairman.
The Plumbing and Heating Industries Bureau, George H. Dickerson.
Report of Legislative Committee, Howard E. Crook, chairman.
Report of Committee on Welding, F. C. Fantz, chairman.
Report of Committee on Air Conditioning, J. Lawrence DeNeille, chairman.
The Disappearance of Trade and Industrial Skill and Knowledge, Dr. Charles A. Prosser, Dunwoody Institute.
Report of Committee on Certification, T. F. Hanley, Jr., chairman.
Report of Committee on Standards, George P. Nachman, chairman.

2 p.m.

Report of Committee on Trade Promotion, Walter Klie, chairman.
Report of Conference Committees Cooperating with National Association of Master Plumbers and Industrial Unit Heater Association.
Forum Hour—Problems of Distribution in the Industry, Walter Klie presiding.

MAY 19

9:30 a.m.

Report on Construction League, John H. Zink.
Report of Boiler Output Committee, Harry M. Hart, chairman.

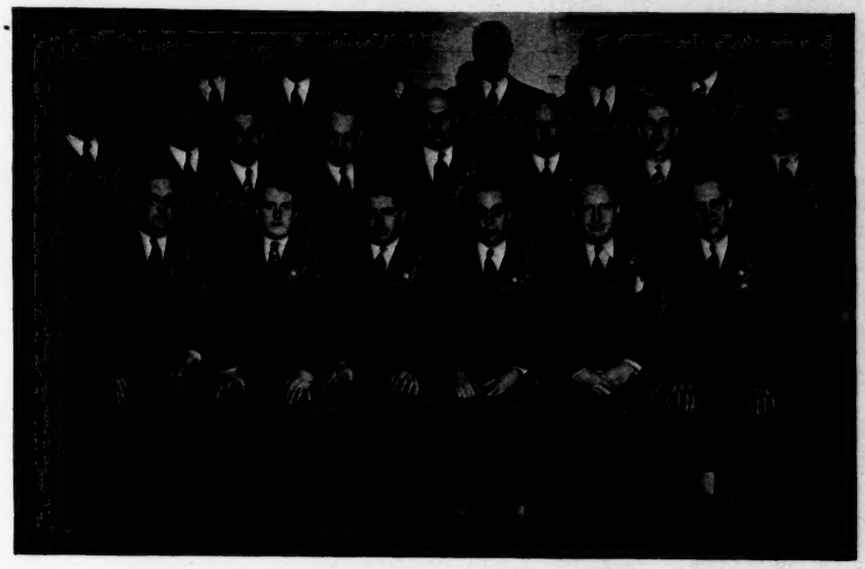
2 p.m.

Report of Convention Committees.
Election of Officers.

Tax on Flues

NEW YORK—Those who have been harassed by income tax woes will be interested to learn that in the year 1657 tenants who paid a "fireplace tax" were allowed to deduct the tax from their rent payments, according to the "1937 Almanac for New Yorkers" compiled by the WPA Federal Writers' Project of New York City and now on sale at local bookstores.

A "chimney tax" of one beaver, or eight florins in cash, was levied against the populace after "fire ladders, hooks, and buckets were purchased by the city for protection against fire." For maintenance of the apparatus, however, an additional tax of one florin was levied against each chimney.



Sales training courses were recently conducted by National Radiator Corp., Johnstown, Pa., and divided into three classes: one class for men who recently joined its sales force, and the other two classes for salesmen who had been with the corporation for some time. Held under the supervision of T. A. Novotney, manager of convector sales, 48 field representatives attended. Classes were conducted on tours through the corporation's plants at Johnstown, New Castle, and Lebanon, Pa. Some of the men attending are shown above. First row—G. A. Baerenklau, D. J. Kenny, J. R. Carney, F. R. Kriebel, T. A. Novotney, E. L. Brundage. Second row—F. B. Baumer, P. R. Fox, J. L. Shaughnessy, V. E. Mero, C. L. Rever, C. B. Foster, F. S. Hudson, Jr., L. A. Kirkland. Third row—C. A. Piez, R. L. Hershberger, W. F. Johnson, C. E. Saverwa'd, F. E. Krell, S. A. Kerrigan.

Radiant Heating is Subject at N. Y. Meeting

NEW YORK—The regular March meeting of the ASHVE New York Chapter drew an attendance of 125 to hear radiant heating and cooling discussed. Five speakers appeared on the schedule but two of them, Dr. Arthur M. Greene, Jr., of Princeton University, and Claude Schmitt, representing a European syndicate on patents on radiant heating, did not appear. In the absence of these two scheduled speakers Dexter Purinton, who presided, outlined his own views on radiant heating and presented Orion O. Oaks, executive engineer of the American Radiator Co., Leon Munier, of Wolff & Munier, Inc., and James Penney, of the Westinghouse Research Laboratories, Pittsburgh.

Mr. Oaks outlined at length the operations of the American Radiator Company in regard to radiant heating. He pointed out that American Radiator subsidiaries have sold large quantities of radiant heating surface in Europe. When the same product is offered in this country, however, virtually no sales have resulted because of the necessity of either installing large amounts of surface or because of having to use excessively high temperatures on the surfaces. Lack of available space has been, Mr. Oaks felt, a serious drawback in connection with the use of full radiant heating surface here. Instead, his company has offered the combination of radiant and convective surfaces which have been widely accepted here. Even now Mr. Oaks stated his company is presenting additional products along these lines. He assured those present that his company is very much interested in radiant heating and that when it is satisfied that this design information is fully ready for release it will be made available to engineers.

Mr. Penney spoke interestingly of the spectacular experiences encountered in a special room built at the Westinghouse Research Laboratories some years ago. In this room the walls could be quickly heated or cooled to almost any desired temperature. Tests showed that even with large amounts of outside air being brought into a room in hot weather the room could be kept comfortable by cooling the walls but that moisture condensed on walls and the amount of refrigeration required to produce the cooling was large. He felt there was no question but that satisfactory cooling by reducing wall temperatures could be obtained but did not feel that this practice was likely to become commercial.

Mr. Munier, whose firm has installed a number of radiant heating installations in this country where the ceiling is used for imbedding the hot pipes, told of the formation of a European syndicate to pool the radiant heating patents and also of European applications of radiant heating to plant growing.

Free Service Bill Killed

HARTFORD, CONN.—House Bill 1330, which prohibited the offering or giving of any free service on oil burners as a means of obtaining fuel oil contracts, has been rejected by the Connecticut legislature. This action is believed to have eliminated any possibility of securing legislation to curb free service in Connecticut, at least until the next General Assembly session in 1939. The text of the bill was published in HEATING & VENTILATING for March.

Hattis Describes A.C. Job

CHICAGO—Robert E. Hattis was the principal speaker at the March meeting of the Illinois chapter, ASHVE. He described the air conditioning installation which he designed for the windowless building of National Aluminate Corp. Here was a job, Mr. Hattis explained, where the executives decided that comfort and facilities for entertaining customers, as well as elimination of smoke, dust, odors, and view of unsightly surroundings, warranted going to windowless construction and a complete air conditioning system. Well water was available for cooling, so it was used, the equivalent of 90 tons of refrigeration being secured for 13 or 14 hp.

Simultaneous heating and cooling were made possible by means of a heating coil and a cooling coil in each branch duct and a very complete control system. Mr. Hattis explained all these methods in detail, as well as how he prevented condensation from humidity in winter, the handling of outside and recirculated air, the cleaning of air, and other problems necessary to overcome. Discussion which followed brought out many interesting features.

Because this job used well water for cooling, the subject of deep wells was an interesting accompaniment and it was treated most capably by Harry P. Barton. Mr. Barton pointed out that ground water supplies vary greatly in different localities and sometimes in just a few feet of distance. He told of the different water bearing strata, their depths, the output to be expected from each, and the temperatures usually obtaining. It seems, however, that the ability to locate these strata and drive a well with the assurance that it will produce is still not a sure thing. He also discussed the types of well pumps.

Including 13 guests from the Wisconsin chapter, 135 were present.

Gas Men Discuss Water Heating

PHILADELPHIA—A symposium at the National Commercial and Hotel & Restaurant Sales Conference was held here under the auspices of the industrial gas section of the American Gas Association in cooperation with the Pennsylvania Gas Association, March 2-3. The subject was "Selling Commercial Water Heating." This symposium was opened and led by L. E. Biemiller, Consolidated Gas, Electric Light & Power Co., Baltimore, who is chairman of the volume water heating committee of the industrial gas section. He brought out the different commercial uses for hot water; various classifications of establishments using hot water heaters, and the volume of hot water usually required by each type of establishment.

After analyzing the hot water requirements of restaurant kitchens Mr. Biemiller stated: "Careful study of commercial hot water requirements will often show that it is possible to meet these requirements with the larger domestic type storage water heaters using the standard heater, or a standard heater which has had the temperature range or generating capacity raised. We have been successful in the application of 52-gal. storage water heaters to loads of this type. The stock heater had an hourly generating capacity of 97 gal. through 60F with an input of 60,000 B.t.u. We conducted laboratory tests and determined that under certain conditions this capacity could be increased to 110 gal. with an input of 70,000 B.t.u."

The development of a gas-fired immersion type storage hot water heater of 150-gal. capacity was urged by Mr. Biemiller. During the discussion that followed it was reported that, under a new method being tried out in Philadelphia, 1400 water heaters were put out last year, on a rental basis. E. A. Lawler, Public Service Electric & Gas Co., Jersey City, N. J., pointed out that apartment houses constituted a large and potential market for large volume gas water heating. While coal and oil now serve this field in a large degree, the high efficiency of gas equipment today puts gas in a favorable position to compete with these fuels. Incinerators for burning refuse, in these same apartments, offers another field.

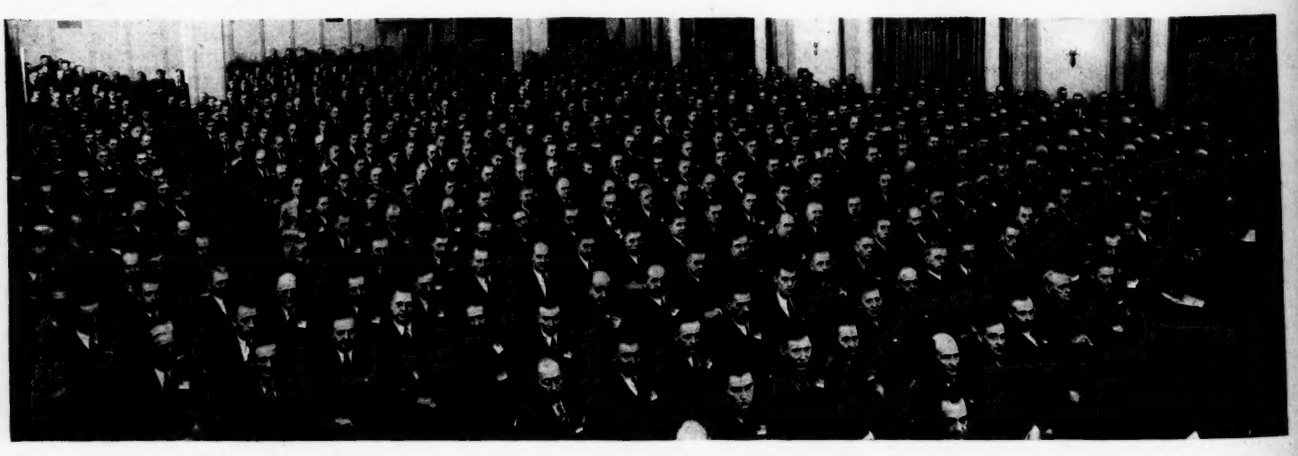
Selling commercial water heaters with a minimum gas consumption guarantee is the practice of the Scranton-Spring Brook Water Service Co., Scranton, Pa., according to M. A. Boylan who stated that they had taken 50 jobs in the past five years running from a few gallons up to 500 gal. L. Ourusoff, Washington Gas Light Co., Washington, D. C., thinks well of a gas immersion water heater which is being tried out in his territory. C. G. Segeler, American Gas Association, stated that more extended use could be profitably made of the water heater tests conducted by Professor Wilkes of the Massachusetts Institute of Technology.

Lane Requests Catalogs

CHICAGO—The Lane Technical High School of this city has opened a library for the use of students interested in air conditioning, and manufacturers are requested to send catalogs dealing with all phases of air conditioning. They should be addressed to The Lane Technical High School, 2501 Addison St., attention Mr. Gotschall.

Adds 2363 Gas Jobs

NEW YORK—The Brooklyn Union Gas Co. reports that 2363 gas-fired house heaters were added to its lines during 1936 as compared with 116 in 1935.



At the 1937 Iron Fireman Convention, held at the Hotel Statler, Cleveland, Ohio.

New York ASRE Inspects Newark Brewery

NEWARK—A joint dinner-meeting of the New York Section of the ASRE and the New Jersey Section held at the Newark Athletic Club on the evening of March 4 drew a record crowd of over 250. Members of the American Institute of Chemical Engineers in the metropolitan area helped to swell the attendance total. The meeting program was arranged under the direction of President James Larkin of the ASRE New York Section. Mr. Larkin presided at the dinner and following the dinner presented the several speakers.

The entire session was given over to a consideration of a new type of refrigeration machine using ammonia by a low pressure condensing system developed by Carrier and installed at the Ballantine Brewery here. Especial interest centers on the development and use of this method which is said to have many possibilities in the chemical industry because certain gases such as chlorine can be condensed directly without the use of any intermediate refrigerant.

At the end of the formally arranged speaking program, buses were provided to carry the party to the Ballantine Brewery where the new machine is in actual operation.

With the meeting held here many Carrier engineers attended and at the close Willis H. Carrier showed some motion pictures in color taken during his recent trip to South Africa.

The Ballantine Brewery installation presented special problems according to the speakers and analysis of its heat balance was made in order that the best possible arrangements in the use of heat could be obtained. It was stated that the general effect of a plan of the kind put into this brewery is that refrigeration is produced as a by-product of the plant operation and that a considerable part of the refrigeration is thus obtained at small operating cost.

Speakers on the program included Willis H. Carrier, Fred Ophuls, Dr. A. A. Berestneff, C. I. Elliott, and S. O. Maxwell.

U. of Wisconsin to Hold A.C. Conference

MADISON, WIS.—A conference on air conditioning and automatic heating is scheduled by the University of Wisconsin for April 21-23. In addition an exhibition of equipment has been arranged and all such available exhibit space is reported to have been disposed of by March 23.

The program follows:

APRIL 21

9:30 a.m.

Welcome Address, Dean F. E. Turneaure, Dean of College of Engineering, University of Wisconsin.

The Human Power Plant, G. L. Larson, chairman, department of mechanical engineering, University of Wisconsin.

Physiological Factors in Air Conditioning, F. C. Houghten, director of research laboratory, ASHVE.

1:30 p.m.

The Automatic Stoker and Its Application to Air Conditioning, K. C. Richmond, editor, *Coal-Heat*.

Simplifying the Selection of Coal for Stoker Use, Marc G. Bluth, secretary, Stoker Manufacturers Association.

Advantages of Combined Stoker-Boiler Units, W. G. Hughes, manager, automatic coal burning division, American Radiator Co.

7:30 p.m.

Overfeed Firing by Pneumatic Spreader Stoker (moving pictures), T. A. Marsh, control division engineer, The Iron Fireman Mfg. Co.

Controls for Air Conditioning and Automatic Heating, J. R. Vernon, Johnson Service Co.

APRIL 22

9 a.m.

Installment Selling as it Relates to Air Conditioning or Automatic Heating, S. M. Zinner, vice-president, Walter E. Heller Co.

Sell Year-Round Air Conditioning—Not Seasonal, D. W. McLenegan, assistant engineer, air conditioning division, General Electric Co.

Selling the Idea of Year-Round Hot Water, R. E. Moore, vice-president in charge of sales, Bell & Gossett Co.

1:30 p.m.

The Gas Industries Position in Relation to Air Conditioning and Automatic Heating, E. D. Milener, secretary, industrial gas section, American Gas Association.

Sales Arguments for Gas Heating in the Air Conditioning Field, B. A. Johnson, manager sales engineering, Peoples Gas Light and Coke Co.

Comparative Merits of Direct and Indirect Fired Air Conditioners, Platte Overton, chief engineer, The Furblo Co.

8 p.m.

A Pioneer Looks Into the Future of Air Conditioning, Willis H. Carrier, chairman board of directors, Carrier Corp.

APRIL 23

9 a.m.

Air Distribution in Air Conditioning Systems, V. M. Lathers, sales engineer, Barber Colman Co.

Air Filters for Air Conditioning Systems, F. B. Rowley, director of experimental Laboratories, University of Minnesota.

Difficulties with Direct Expansion Evaporating Coils when Elevated Above Condensers, William Goodman, engineer, The Trane Co.

1:30 p.m.

Why Sell Oil Burners, J. W. Manny, president, Chicago Oil Burner Association.

Cooperation Between Fuel Oil Distributors and Automatic Heating Industry, F. E. Spencer, president, Burning Oil Distributors Association.

Insulation and Condensation, William Cullin, chief engineer, Johns-Manville Co.

Johnson on Committee

NEW YORK—American Institute of Mining & Metallurgical Engineers announces the appointment of Allen J. Johnson, director of the Anthracite Industries Laboratory, Primos, Pa., as a member during the current year of its committee on correlation of research. Mr. Johnson was also reappointed to serve on the committee on "use of coal" of the same organization, on which committee he has served for several years.

Macy S. Good

CHICAGO—Macy S. Good, assistant sales manager of C. A. Dunham Co. of this city, died March 3 after a short illness. He was 64 years of age.

Born in Richmond, Ind., on May 14, 1873, Mr. Good attended Purdue University, graduating in 1899. Immediately after graduation he entered the plant of the American Locomotive Co., Dunkirk, N. Y., later engaging in railroading on the Burlington and Illinois Central preparatory to selling railroad equipment and steel. He was connected with the sales organization of Nubian Paint and Varnish Co. for several years prior to his joining Dunham. In 1921 he became manager of Dunham's Chicago sales office, and in 1936 was made assistant sales manager. He was well known and highly respected throughout the industry.

He is survived by his widow and daughter.

Clarence M. Lyman

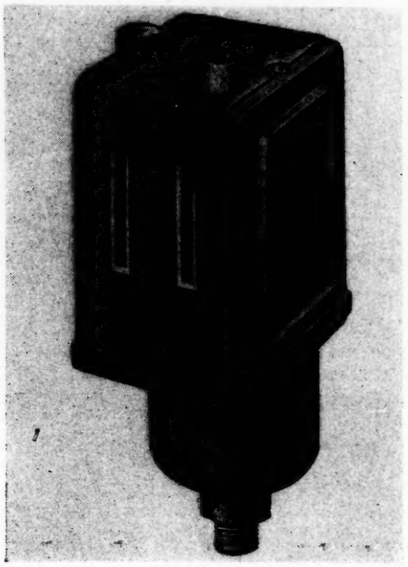
UTICA, N. Y.—Clarence M. Lyman, well known for his work in research and code formulating in the warm air heating industry, and an executive of International Heater Co. of this city, died suddenly February 28 at the age of 78.

Born in Ripon, Wis., Mr. Lyman was educated at Williston Seminary and Oberlin College. After graduation he spent ten years in Chicago as a salesman, going from there to Philadelphia where he entered the heating business and afterwards moved to New York.

In 1896 he joined Russel Wheeler & Son as a salesman. This was one of the companies which consolidated with other companies to form the present International Heater Co. He was a salesman for the company in New York and New England for ten years and then for two and a half years was secretary of the Townsend Hardware Co., Oneonta, N. Y. In 1911 he returned to Utica as advertising manager of International Heater, and later was made eastern sales manager.

During the World War Mr. Lyman was a "dollar-a-year-man" and had much to do with the heating of cantonments. He was a charter member of the National Warm Air Heating & Air Conditioning Association and was honorary chairman of its code committee.

NEW EQUIPMENT



Ranco Steam Boiler Control

NAME AND MODEL NUMBER—Ranco R L B.

PURPOSE—Steam boiler control.

FEATURES—Manufacturer states that the instrument is easy to install and inspect since the cover snaps on and off. The dial pointer and cap are interchangeable between range and differential screws. The screws are independently adjustable. All parts are made of steel heavily cadmium plated. It is said that the new principle used in switch toggle gives low differential, wide break and positive contact pressure in the fine silver contacts. All springs are either heavily plated or are made of stainless steel. The knife edges of all toggles are machined and hardened. For standard operation, the contacts open on an increase of pressure and the cut-in pressure plus the differential equals the cut-out pressure. A control which closes the contacts with an increase of pressure can also be obtained.

PRESSURE RANGES AVAILABLE—Three ranges, the first ½ to 15 lb. with a differential of 1½ to 6 lb., the second 5 to 50 lb. with a differential of 10 to 25 lb., the third 5 to 150 lb. with a differential of 10 to 35 lb.

LITERATURE AVAILABLE—Bulletin No. 700.

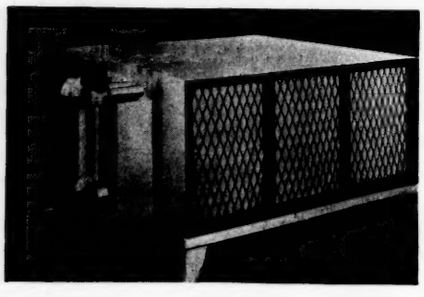
MADE BY—*Ranco, Inc., 601 W. 5th Ave., Columbus, Ohio.*

Fedders Unit Conditioners

NAME—Fedders "all-season" unit conditioners.

PURPOSE—For summer and winter air conditioning.

FEATURES—Conditioners are self-contained units, cataloged and delivered on a package basis for combined air filtering, cooling, heating and humidifying, or for heating or cooling only. They are shipped ready to install and coil surface is available for use with refrigerant, cold water, steam and hot water. Direct expansion coils are equipped with Fedders high capacity thermostatic expansion valves which are said to provide a sensitive adjustment and accurate refrigerant control in accordance with the varying temperature differentials encountered as the air passes through the coil. High efficiency centrifugal blowers driven by V-belts are used to supply large volumes of air. Humidification is by means of a self-cleaning nozzle which ejects a fog into the air stream. Operation of this humidifier can be controlled either manually or automatically. Fedders all-copper coil surface is used in the units. These coils are made of copper tubing and are tested with 3000 lb. pressure during fabrication and with 300 lb. air pressure after assembly. A filter section containing a double filter of the removable type is also provided.



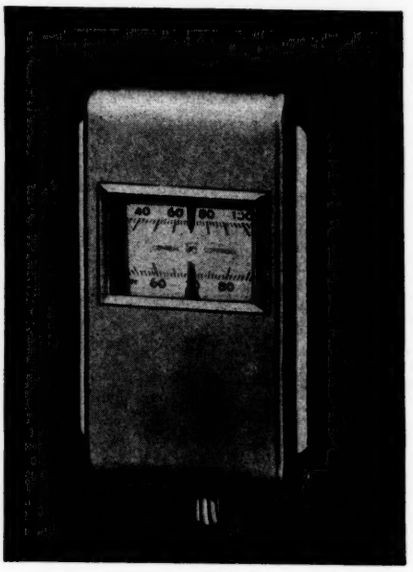
CAPACITIES—Three to fifteen tons.

MADE BY—*Fedders Manufacturing Co., Inc., Buffalo, N. Y.*

General Controls Thermostat

NAME—Metrotherm.

PURPOSE—For controlling air temperatures.



FEATURES—Thermostat is of the low thermal inertia type and contains a small rheostat for adjusting the amount of heat acceleration. Maximum sensitivity to small temperature change is said to be obtained. Two needle-like indicators show the temperature setting and the actual room temperature. Locking device standard equipment. Also available with a timer.

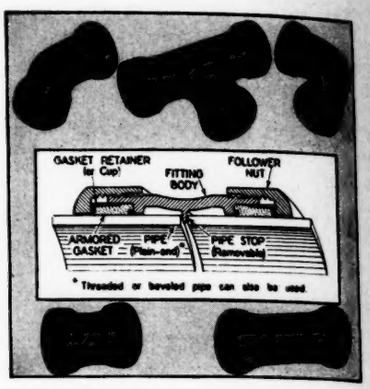
MADE BY—*General Controls Co., 1370 Harrison St., San Francisco, Calif.*

Dresser Compression Pipe Fittings

NAME AND MODEL NUMBER—Dresser compression fittings, style 65.

PURPOSE—Self-contained pipe joints for tight and flexible connections on plain-end pipe.

FEATURES—The fitting comes completely assembled and can be installed by using only a wrench. Principles of operation are as follows: two threaded "follower" nuts when screwed up on the threaded body of the fitting, compress two resilient, rubber compound gaskets tightly around the pipe, thus sealing the joints. It is said that the specially compounded gaskets are made to last as long as the pipe itself and to retain their original resilience in service for many years. Each gasket is provided with flexible, metallic armor which protects the body of the gaskets from the contents of the line and makes a joint of high electrical conductivity. Although no special preparation of the pipe ends is necessary these fittings will take a threaded or beveled pipe. It is said that the fittings can be used on gas, water, oil, compressed air, chemical and industrial production pipe lines.



SIZES AVAILABLE—Standard length couplings for pipe sizes from ⅜ to 2 in.; extra long couplings, 45 ells, 90 ells, and tees for pipe sizes from ½ to 2 in. Adapters for providing "Dresser end" on various threaded fittings. Tee with a threaded branch for pipe sizes from ¾ to 2 in. Couplings, style 75, with the body internally threaded to take threaded-end pipe, and to act as an added protection against excessive thrust, pull or shock.

MADE BY—*S. R. Dresser Manufacturing Co., Bradford, Pa.*

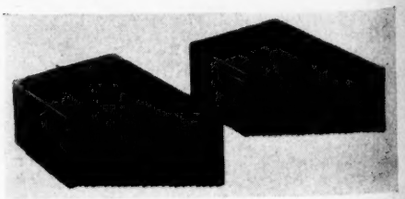
Modine Hot Water Convector

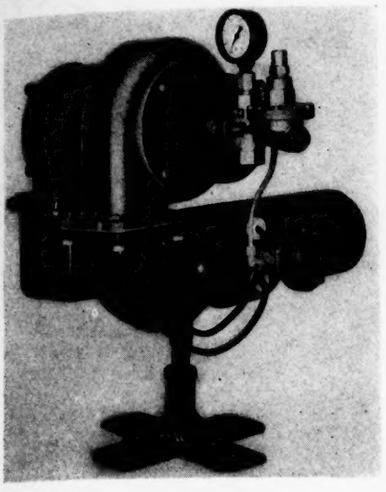
NAME—Modine hot water copper convector.

PURPOSE—Convector designed especially for hot water.

FEATURES—Oval, seamless copper tubes instead of round tubes are used in these convectors. Four times as much tube surface is used in the hot water units as in the Modine steam units, resulting in a ratio of prime surface (tubes) to secondary surface (fins) of one to four. The manufacturer states that the use of this convector makes possible a performance that in comparison with steam is subject to no penalty of capacity other than that arising from the direct ratio of the temperature of the two heating media. It is said that by installing hot water type Modine convectors in a hot water system no additional heating capacity over and above that regularly required for ordinary direct radiation need be added.

MADE BY—*Modine Manufacturing Co., Racine, Wis.*





Scott-Newcomb Oil Burner

NAME — Scott-Newcomb conversion burner, Model CJH.

PURPOSE—A conversion burner designed particularly for compactness when space conditions are at a premium, such as burners that are enclosed in jackets and standard boilers.

FEATURES—The transformer is mounted underneath the motor. The air blast tube which is a departure from the Scott-Newcomb standard curved air duct, is made with its center line in the center of the blower housing. All other parts are standard.

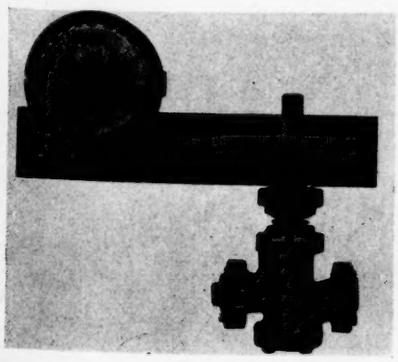
MADE BY—*Scott-Newcomb, Inc., 1922 Pine St., St. Louis, Mo.*

Brown Area Flow Meter

NAME—Brown area meter.

PURPOSE—For metering refrigerating fluids.

FEATURES—Manufacturer states that the instrument is well adapted to metering refrigerating fluids since measurement is not one of pressure differentials. The meter is of a constant head, variable orifice type. Pressure differential is held constant by balancing the weight of the piston against the pressure drop across an orifice which is contained in the meter body. The position of the piston is transmitted electrically by the inductance bridge principle to the indicator or recorder. The meter is connected into a pipe line like a valve and its range may be changed by the addition or removal of weights in the hollow piston. By this means, changes in the capacity of the meter of approximately 20% can be obtained. Further changes in capacity can be obtained by the installation of a new orifice sleeve which may be of bronze or stainless steel depending upon the nature of the fluid to be measured. A cast iron meter body is supplied for pressure up to 250 lb. and a cast-steel body for pressure up to 600 lb. The maximum temperatures must not exceed 600F.



Meter can be supplied as an indicator, recorder, indicator-integrator, or recorder-integrator. An electrical transmitting system makes it possible to install the meter at a remote point from the meter body.

SIZES AND CAPACITIES—Furnished in one size only with 2 in. flanges. Based on water flow measurement, the minimum range is 150 gal. per hr. and the maximum 2000 gal. per hr. For other fluids the actual capacity is determined from the ratio of the square root of the density of the fluid compared to the square root of the density of water at the same temperature.

LITERATURE AVAILABLE—Catalog 2004.

MADE BY—*Brown Instrument Co., Division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.*

American Radiator Boiler Humidifier

NAME AND MODEL NUMBER—American Radiator boiler humidifier, Nos. 10 and 11.

PURPOSE—A humidifying boiler attachment for supplying moisture to room air without the use of ducts.

FEATURES—Humidifier supplies moisture to the house through a 3-in. pipe and is made in two different models; one, the No. 10, for attachment to any boiler and the other, No. 11, is constructed as an integral part of the hot water heater in the company's No. 11 oil burning boiler. It is said that heat exchangers are employed in both models so that superheated water vapor is supplied. Manufacturer states that super-heating the water vapor and

warming the air that supplies it, prevents condensation in the pipe and at the outlet grille and at the same time makes it possible to handle a sufficient volume of moisture to meet the needs of the entire house.

METHOD OF OPERATION—A fine stream of water is played against a heated cast iron surface through a spray nozzle which is operated either manually or automatically by a solenoid valve. Air circulation is provided by a small blower that has a capacity of 40 c.f.m. Humidifier is intended to evaporate approximately 12 gal. of water per day and can be used on either steam or hot water boilers.

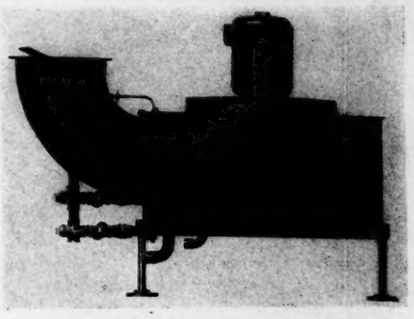
MADE BY—*American Radiator Co., New York.*

General Refrigeration Evaporative Condenser

NAME—Hydro-Cyclonic condenser.

PURPOSE—For removing the heat from compressed refrigerant by vaporizing water.

FEATURES—Condenser is self-contained and includes a complete assembly of tank, condenser coil, motor fan, water lift, float control, and water valves. The condenser coil consists of a series of flat pancake coil sec-



tions installed in a circular tank and connected to a refrigerant inlet header on the outside end of the coil and a liquid outlet header on the inside end of the coil. Each coil section slopes downward, permitting the condenser refrigerant to drain from the tubes into the liquid outlet header.

A vertical rubber-mounted enclosed motor is supported over the air inlet tunnel forming the top of the tank. A special fan with a conical water lift hub is directly attached to the bottom of the motor shaft extension.

METHOD OF OPERATION—Water from the bottom of the tank is raised by the water lift to the fan blades where it is mixed with the air passing through the fan. The spray is then propelled by centrifugal force over the hot refrigerant coils. Heat in the coils is transferred to the evaporating water and the moisture is carried off in the discharge air stream. Manufacturer states that it is not necessary to remove the coils to clean them as they can be completely submerged and flushed clean. Only one motor is used and no pump is required.

TYPES AND SIZES AVAILABLE—Three sizes, for use with methyl chloride and Freon with condensing capacities for compressors ranging from 15,000 to 120,000 B.t.u. per hr.

LITERATURE AVAILABLE—Form 214 and Specification Sheets EC-35, EC-70, and EC-90.

MADE BY—*General Refrigeration Sales Co., Beloit, Wis.*

Reliance Condensing Units

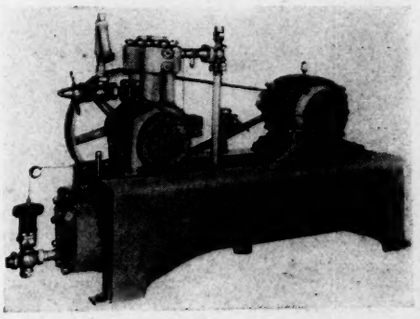
NAME AND MODEL NUMBER—Reliance condensing units, type WAR 1500 and WAR 2000.

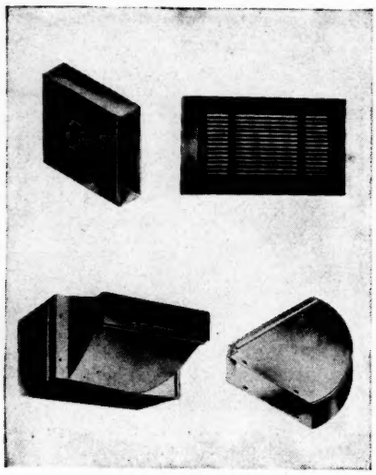
PURPOSE—Compressors and condensing units for air conditioning.

FEATURES—Compressor design permits use of Freon, methyl chloride, or ammonia refrigerants. Timken bearings. Forced feed lubrication. Rotary or double mechanical seal on stuffing box. Larger compressor valve area is provided by use of ring plate valves, made of special Swedish spring steel. Compressors have safety heads and water-cooled jackets. Shell and tube condenser, welded construction to avoid any possibility of leaks. Removable for cleaning.

SIZES AND CAPACITIES—1 hp. to 60 hp.

MADE BY—*Reliance Refrigerating Machine Co., Chicago, Ill.*





American Radiator Ducts

NAME—Prefabricated air ducts.

PURPOSE—To eliminate the necessity for sheet metal work to provide ducts for the company's air conditioning systems.

FEATURES—The prefabricated ducts, it is said, make it possible for a contractor to install one of the company's systems without any previous knowledge of sheet metal practice or without special tools to construct ducts for air delivery. Complete fittings and grilles are supplied with the mains for the installation. The units are manufactured with snap lock joints to insure air tight performance and to allow an easy fit and an interchangeability of parts. Manufacturer states that the variety of combinations possible with the air mains permits practically all job conditions to be met and any air distributing system to be installed.

MADE BY—*American Radiator Co., New York.*

Ranco Temperature and Pressure Control

NAME AND MODEL NUMBER — Ranco temperature and pressure control, type RM.

PURPOSE—For use where temperature or pressure must be held to very close limits and to compensate for overrun.

FEATURES—The control is a combination of an auxiliary switch mechanism operated by a temperature or pressure bellows, and a magnetically operated contactor. It is said that the auxiliary contacts require very little power for operation, making possible a very low differential. The main contacts are closed by a magnet under heavy pressure with a quick make and break, providing a large current carrying capacity (1 hp., 110-220 volts, a.c., or 115—230 volts d.c.). Available in temperature ranges from — 20F to + 90F. Temperature differential adjustable from 1F to 7F.

MADE BY—*Ranco, Inc., Columbus, Ohio.*

G.E. Oil-Burning Winter Conditioner

NAME AND MODEL NUMBER—Oil-fired warm-air conditioner, type LB-3.

PURPOSE—For supplying cleaned, moistened and heated air utilizing oil as a fuel.

FEATURES—Oil burner utilizes the same principles which have been used in previous G.E. equipment. Air is supplied by an aphonic radial flow fan. Large viscous filters are used for cleaning. Compressor motor is self-lubricated with fuel oil, burner nozzle is air-cooled and ignition is by an electric spark. Heating unit is made of welded copper bearing steel. A humidistat is provided to control the amount of moisture and a snap action thermostat to maintain the temperature.

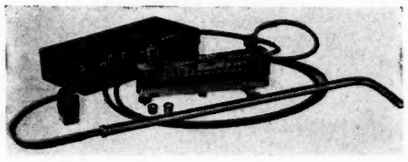
MADE BY—*General Electric Co., Bloomfield, N. J.*

Friez Air Meters

NAME—Friez air meter set.

PURPOSE—To give easy readings of static pressures, velocities, air volumes and drafts.

FEATURES—Complete outfit is made up of a gage, tubing, fittings, oil and data sheets in a stiff carrying case. A unique feature of



the meter is the chromium plated and highly polished graduated scale which reflects the image of the liquid column through the transparent Bakelite body of the instrument. This is said to completely eliminate the error from parallax. A built-in level with adjustment and a scale adjustment are incorporated in the instrument.

CAPACITIES—Various ranges are available covering velocities from 400 to 8000 f.p.m. and pressures or vacuums from 0.005 in. of water up to 4.0 in. of water.

MADE BY—*Julien P. Friez & Sons, Inc., Baltimore, Md.*

Sarco Bucket Trap

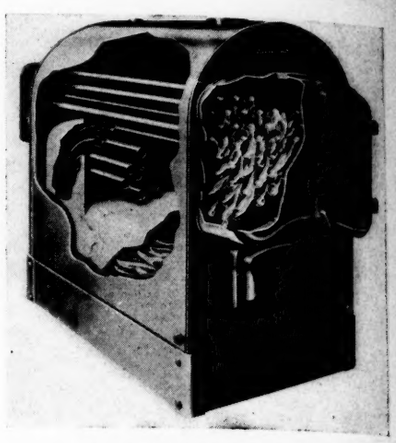
NAME—Sarco bucket trap.

PURPOSE—A steel trap of the converted bucket type. Manufacturer states that this trap was designed to complete the company's line and is not intended to compete with very light, low-priced units.

FEATURES—Trap uses the same type of valve mechanism as the other Sarco float-thermostatic traps. It can be furnished with an integral air bypass carried inside the bucket and consisting of a thermostatic trap element of the balanced pressure type. It is said that the air bypass never requires resetting and operates satisfactorily regardless of pressure fluctuations in the trap. Available with bodies of cast iron for pressures up to 125 lb., semi-steel for pressures to 250 lb., and cast steel for pressures up to 500 lb. Valve heads and seats are of stainless steel.

SIZES AVAILABLE—½ to 2 in.

MADE BY—*Sarco Co., Inc., 183 Madison Ave., New York.*



Spencer Steel Boiler

NAME AND MODEL NUMBER—Spencer type "A" steel heating boiler.

PURPOSE—For supplying steam utilizing any type of fuel.

FEATURES — Three-inch tubes provide for long fire travel and accessibility for cleaning. All tubes may be replaced without removal of the breeching. Doors are of a heavy cast iron and the flue cover doors are heavily ribbed. Tubes can be cleaned through the front flue doors while the boiler is in operation. Manufacturer states that the ease with which changes from one fuel to another may be made is a valuable feature of this boiler. Provision is made for a submerged water heater and either a storage type coil or instantaneous type can be supplied.

CAPACITIES—Steam capacities of 1600 to 7260 ft. (S.H.B.I. rating).

MADE BY—*Spencer Heaters, Division Lycoming Manufacturing Co., Williamsport, Pa.*

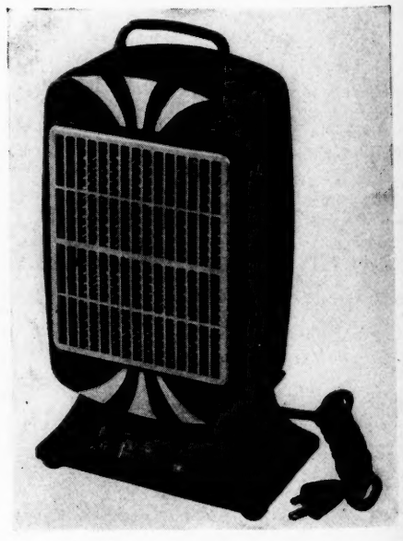
Hexcel Portable Electric Heater

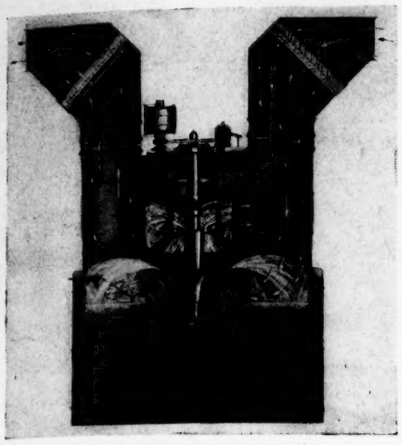
NAME—Hexcel Junior portable electric heater.

PURPOSE—For supplying heat utilizing electricity.

FEATURES—Heating unit is made of nichrome wire, utilizes 11 amperes at 115 volts and has a heating capacity of 4265 B.t.u. per hr. A motor-driven fan supplies 360 cu. ft. per min. of air to the heater. Unit is housed in a drawn steel case with a cast iron base and is furnished in brown crackle with trimmings of chromium. Dimensions: 13½ in. high; 7½ in. wide, and 6 in. deep.

MADE BY—*Hexcel Radiator Co., Racine, Wis.*





Utica Air Conditioner

NAME—Utica air conditioner.

PURPOSE—A conditioner for filtering and humidifying air with attachments available to make it a complete year-round conditioning unit.

FEATURES—The basic features of the unit are a Turbinator and Aqualute. The Turbinator is a device which throws two sprays of water. The first, a heavy spray to wash the air, and the second, a slow moving mist spray for a complete humidification treatment.

The Aqualute is a device which scrubs and slows down the air velocity and at the same time it is said to eliminate all entrained moisture. When the unit is used for heating, the discharge header connects with the cold air intake of a warm air furnace or if combined with a boiler, a heating coil of the correct size is placed in the header to heat the air passing through.

For summer, refrigerating cooling coils are hung partly submerged in the water pan and connected with a refrigerating compressor of the proper size. A super-cooling coil also in the same circuit is located at the discharge header. The sole purpose of the refrigerating cycle is to cool the spray water to 40 or 45F. A single power assembly, floating on rubber, drives the unit with a single ¼-hp. motor through interchangeable pulleys and V-belt. A standard throw-away filter is located in the intake header.

SIZES AND CAPACITIES — Four standard sizes with capacities ranging from 500 to 5400 c.f.m. with heating capacities from 7500 to 480,000 B.t.u., and cooling capacities from 1½ to 20 tons i.m.e.

MADE BY—*Utica Radiator Corp., Utica, N. Y.*

American Radiator Coal-Burning Water Heater

NAME — Kolflash coal-burning domestic hot water heater.

PURPOSE—A coal burning hot water heater for supplying domestic hot water.

FEATURES—Heater has a fuel capacity of 41 lb. and is designed to burn pea coal. Equipped with a removable ashpan and when installed without the automatic regulator the firedoor is made with a slide damper and manually operated draft door. Offered with or without self-contained jacketed storage tank and automatic regulator.

CAPACITY—30 to 40 gal.

MADE BY—*American Radiator Co., 40 W. 40 St., New York.*

Hynes Electric Heater

NAME AND MODEL NUMBER — Hynes electric heater, type HBS.

PURPOSE—For heating rooms where an adequate power supply is available to heater.

FEATURES—Heater is designed to be placed on or near the floor. It is said that it needs no attention beyond oiling once a year and that it can be accurately controlled by a thermostat. It is usually mounted permanently but can also be used as a portable heater when desired. Heavy duty cable, plug and wall receptables are provided. Heater case is constructed of heavy welded steel and the front has an air diffusing grille which is said to spread the air flow and prevent drafts. The heating elements are guaranteed for five years against burn-outs. Air is forced over the heating coils by a slow speed fan wheel. A thermal safety device mounted in the heating chamber cuts off the power supply if the temperature rises above normal.

SIZES AVAILABLE—Two sizes with maximum current consumption of 2500 and 5000 watts. Available for 115, 220—230 volts, a.c. or d.c.

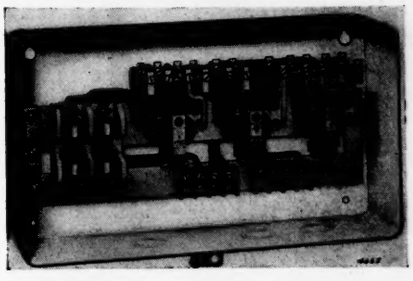
LITERATURE AVAILABLE—Bulletin No. 11.

MADE BY—*Hynes Electric Heating Co., 240 Cherry St., Philadelphia, Pa.*

Allen-Bradley Alternator

NAME—Automatic alternator pilot control panel.

PURPOSE — For automatically alternating duplex units such as refrigeration units, fans, compressors, pumps or motors where alternate operation of the units is desired.



FEATURES—In many duplex installations of equipment where two units are installed—one to carry the load and the other to be held in reserve for peak loads, it is customary to alternate the load between the two units to distribute wear. Although this control panel was developed primarily to operate duplex pump installations, it can also be used on any other duplex equipment installations as noted above. The panel is composed of three Allen-Bradley Bulletin 700 relays. Pilot control device which operates alternator may be a pressure switch, vacuum switch, thermostat, two-wire pushbutton, or float switch.

MADE BY—*Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis.*

Miller Standard Arc Welders

NAME—Portable arc welders.

PURPOSE—A portable device for arc welding.

FEATURES—The manufacturer states that these welders are equipped with a rotary knife switch control with amperage marked for each welding step and that they have the same efficiency as the regular Miller welders. They are said to be lighter in weight because the cabinet is of wood and because there are less amperage controls than on the regular welders. They are specially designed transformer type without reactance control or sheet metal attachment.

CAPACITIES—Four models at 130 to 300 amperes; prices range from $90 to $220.

MADE BY—*The Miller Electric Mfg. Co., Appleton, Wis.*

Emerson-Electric Air Circulators

NAME—Emerson-Electric air circulators, 1937 model.

PURPOSE — For circulating air in offices, homes, and commercial establishments.

FEATURES—The 24- and 30-in., two-speed models for alternating current, and 24- and 30-in., one-speed models for direct current, are of an improved three-blade type with highly polished formed aluminum blades. The 24-in., one-speed model for alternating current has a four-blade fan. All types can be used with either style of mounting accessories, ceiling, wall bracket, counter or adjustable floor column.

SIZES—24 and 30 in.

MADE BY—*The Emerson Electric Mfg. Co., St. Louis, Mo.*

American Coppercote Protective Coating

NAME—Coppercote.

PURPOSE—A waterproof, protective coating for preventing corrosion.

FEATURES—Coppercote is applied like a paint and is said to seal the surface with a flint like sheathing of metallic copper. It is a liquid composition of fine atoms of pure metallic copper held in suspension in a vehicle which covers and seals the surface to which it is applied with a coating of pure metallic copper that is said to be rustproof, waterproof, and fire-resistant. The manufacturer states that it is particularly adaptable to the surfaces of air conditioning apparatus, such as the lining for spray chambers or drip pans where there is a continuous presence of moisture.

MADE BY—*American Coppercote, Inc., 480 Lexington Ave., New York.*

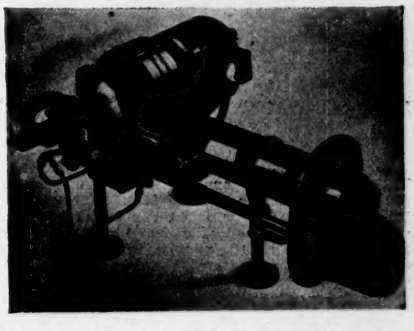
Norge Gas Conversion Burners

NAME AND MODEL NUMBER—Norge gas conversion burner No. GB-18.

PURPOSE—For home-heating utilizing gas.

FEATURES—Gas burner has a motor-driven blower for creating positive draft. It is said that complete gas combustion is secured through the conduction of air through three separate tubes, one directly to the flame, one to the outside of the flame, and one to the inside of the flame. Each of these tubes is controlled from the outside, permitting the direction of an exact amount of air to each part of the flame. Safety features include a low-burning gas pilot which operates in six seconds to cut off the gas supply in case a pilot light goes out; a three-step starting gas valve; outside pilot lighter and gas pressure regulator; and a low-voltage thermostat. Gas burner is also available in combination with the Norge Fine-Air furnace.

MADE BY—*Norge Heating and Conditioning Div., Borg-Warner Corp., Detroit, Mich.*



Degree-Day Figures for February, 1937

HEATING & VENTILATING continues its ninth year of publishing degree-day data for various large cities.

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for February, 1937.....	972	570	792	530	891	1020	1100
Degree-days, Sept. 1, 1936 to Feb. 28, '37	3434	2058	3020	1809	3906	4444	5237
Degree-days, Sept. 1, 1935 to Feb. 28, '36	5058	2789	3780	2541	4602	5214	6046
Degree-days, Sept. 1 to Feb. 28, Normal	4867	2370	3462	2079	4322	4767	5601

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for February, 1937.....	1080	1079	882	953	915	881	1219
Degree-days, Sept. 1, 1936 to Feb. 28, '37	5505	4468	3630	3952	3787	4534	5162
Degree-days, Sept. 1, 1935 to Feb. 28, '36	5441	5309	4470	4813	4678	4387	5965
Degree-days, Sept. 1 to Feb. 28, Normal	5178	4582	3666	4440	4113	4273	4935

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for February, 1937.....	1031	883	1487	441	963	818	1034
Degree-days, Sept. 1, 1936 to Feb. 28, '37	4557	2979	7148	2289	4091	3333	4404
Degree-days, Sept. 1, 1935 to Feb. 28, '36	5320	4337	7706	2026	4945	4045	5308
Degree-days, Sept. 1 to Feb. 28, Normal	4719	3958	6634	2101	4426	3348	4512

	Grand Rapids, Mich.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Kansas City, Mo.	La Crosse, Wis.	Lincoln, Neb.
Degree-days for February, 1937.....	1059	896	897	967	947	1352	1119
Degree-days, Sept. 1, 1936 to Feb. 28, '37	4648	3714	3985	3986	4064	5877	4940
Degree-days, Sept. 1, 1935 to Feb. 28, '36	5333	4442	4618	4854	4730	6439	5629
Degree-days, Sept. 1 to Feb. 28, Normal	4863	4077	4416	4099	4216	5579	4696

	Little Rock, Ark.	Los Angeles, Calif.	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.
Degree-days for February, 1937.....	582	266	816	1271	624	1146	1445
Degree-days, Sept. 1, 1936 to Feb. 28, '37	2511	1066	3327	5548	2496	4941	6323
Degree-days, Sept. 1, 1935 to Feb. 28, '36	3060	769	4074	6253	3151	5680	7010
Degree-days, Sept. 1 to Feb. 28, Normal	2380	1016	3327	5556	2470	5185	5950

	Nashville, Tenn.	New Haven, Conn.	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma, City, Okla.	Omaha, Neb.
Degree-days for February, 1937.....	696	881	262	845	646	685	1197
Degree-days, Sept. 1, 1936 to Feb. 28, '37	2658	3778	830	3387	2190	3203	5265
Degree-days, Sept. 1, 1935 to Feb. 28, '36	3440	4443	1297	4080	2971	3433	5976
Degree-days, Sept. 1 to Feb. 28, Normal	2922	4230	965	3870	2583	2986	4765

	Peoria, Ill.	Philadelphia, Pa.	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.
Degree-days for February, 1937.....	1040	814	890	969	652	865	862
Degree-days, Sept. 1, 1936 to Feb. 28, '37	4508	3237	3553	4577	3283	3845	3537
Degree-days, Sept. 1, 1935 to Feb. 28, '36	5402	3940	4431	5139	3334	4535	4309
Degree-days, Sept. 1 to Feb. 28, Normal	4673	3629	3947	4985	3174	4315	4082

	Richmond, Va.	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.
Degree-days for February, 1937.....	722	1002	880	912	421	968	659
Degree-days, Sept. 1, 1936 to Feb. 28, '37	2724	4352	3646	4611	1929	4138	3355
Degree-days, Sept. 1, 1935 to Feb. 28, '36	3464	5147	4410	4239	1653	4932	3254
Degree-days, Sept. 1 to Feb. 28, Normal	2933	4825	3652	4144	1770	4552	3309

	Spokane, Wash.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for February, 1937.....	1017	990	1011	852	1053	797	877
Degree-days, Sept. 1, 1936 to Feb. 28, '37	5285	4317	4343	3528	4580	3070	3872
Degree-days, Sept. 1, 1935 to Feb. 28, '36	5072	5168	5217	4304	5499	3825	4263
Degree-days, Sept. 1 to Feb. 28, Normal	4707	4980	4465	3715	4966	3559	3773

To obtain unit fuel consumption figures for any city shown above, multiply the number of degree-days by the following factors: for coal, 0.008; for oil, 0.00069; for gas, 0.096. Figures obtained will show coal consumption in pounds per square foot of radiator surface; oil consumption in gallons per square foot; gas consumption in cubic feet per square foot—all for the period covered by the number of degree-days. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operation at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal; 140,000 B.t.u. per gal. for oil, and 1,000 B.t.u. per cu. ft. for gas. To correct for other heating values, efficiency and design conditions, follow the method explained in the "HEATING & VENTILATING Degree-day Handbook" or on H. & V.'s Reference Data Sheet Nos. 67 and 68. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

"I advise Anaconda Copper Tubes to replace rusted piping"

Where Anaconda Copper Tubes are used to advantage:

Plumbing: Hot and cold water lines.

Heating: Low pressure steam lines. Hot water lines. Fuel lines.

Refrigeration and Air Conditioning: Refrigerant circulation lines. Humidifying apparatus.

Mechanical uses: Pressure lubricating systems. Hydraulic pressure lines (low pressure). Circulating lines for lubricants. Low pressure steam and air lines. Pump equipment. Fluid conveying lines.

Process uses: Pipe lines for—Breweries, Distilleries, and Wineries; Textile Mills, Paper Mills, Sugar Mills, Chemical Plants, etc.

ANACONDA Deoxidized Copper Tubes are a better investment than rustable piping... First cost is very little more, because soldered connections eliminate threading. For this reason, Anaconda Copper Tubes have thinner walls, are lighter in weight, and cost correspondingly less per foot.

Anaconda Copper Tubes are supplied in 3 wall thicknesses: Types "K", "L" and "M", which conform to U. S. Govt. Specification No. WW-T-799 and A. S. T. M. Specification No. B-88-33. *A complete line* of both tubes and fittings is now furnished by The American Brass Company. Readily available through leading supply houses in all sections of the country.

ANACONDA 3753

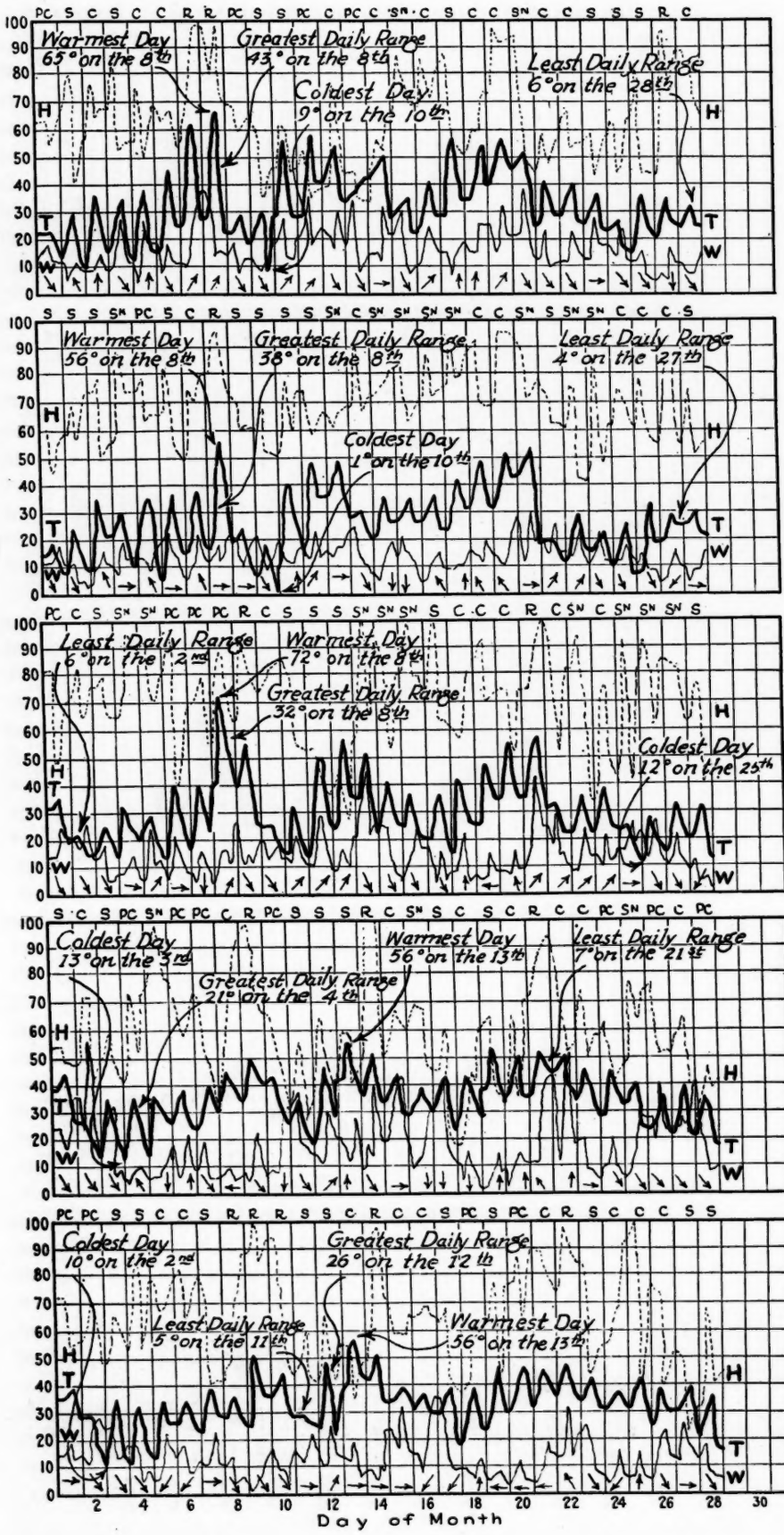
Anaconda DEOXIDIZED Copper Tubes

THE AMERICAN BRASS COMPANY, General Offices; WATERBURY, CONNECTICUT

Offices and Agencies in Principal Cities . . . . In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

THE WEATHER FOR FEBRUARY, 1937

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


Warmest Day 65° on the 8th
Greatest Daily Range 43° on the 8th
Coldest Day 9° on the 10th
Least Daily Range 6° on the 28th
Warmest Day 56° on the 8th
Greatest Daily Range 38° on the 8th
Coldest Day 1° on the 10th
Least Daily Range 4° on the 27th
Least Daily Range 6° on the 2nd
Warmest Day 72° on the 8th
Greatest Daily Range 32° on the 8th
Coldest Day 12° on the 25th
Coldest Day 13° on the 3rd
Greatest Daily Range 21° on the 4th
Warmest Day 56° on the 13th
Least Daily Range 7° on the 21st
Coldest Day 10° on the 2nd
Greatest Daily Range 26° on the 12th
Least Daily Range 5° on the 11th
Warmest Day 56° on the 13th
H
T
W
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

St. Louis

Mean temp. for month, 33.6F; aver. wind velocity, 14.8 m.p.h.; prevailing direction of wind, NW.

Chicago

Mean temp. for month, 26.4F; aver. wind velocity, 12.5 m.p.h.; prevailing direction of wind, W.

Pittsburgh

Mean temp. for month, 30.6F; aver. wind velocity, 13.0 m.p.h.; prevailing direction of wind, SW.

New York

Mean temp. for month, 34.9F; aver. wind velocity, 15.5 m.p.h.; prevailing direction of wind, NW.

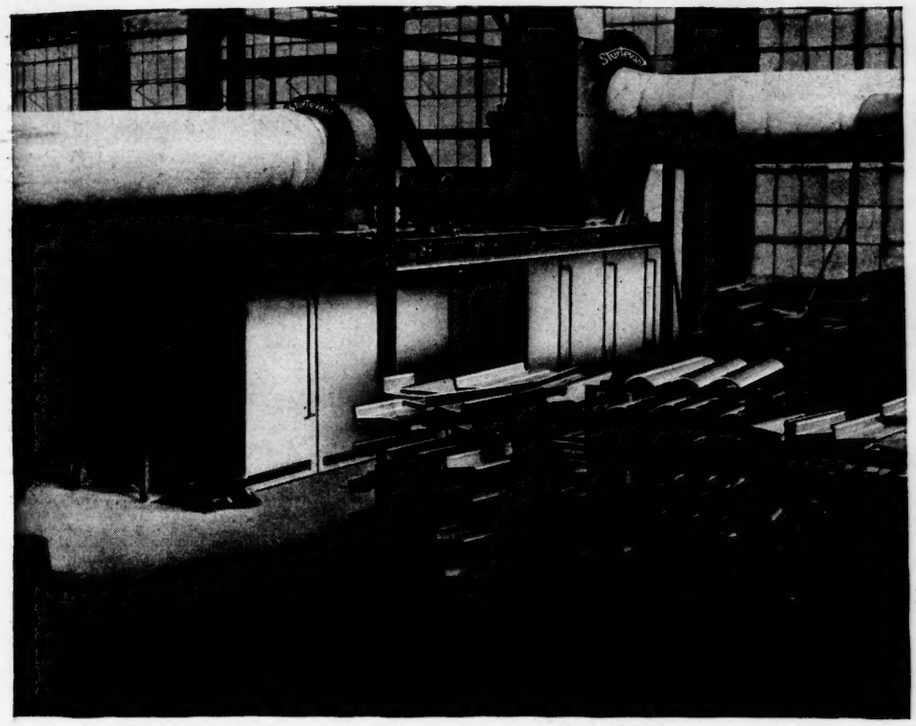
Boston

Mean temp. for month, 33.2F; aver. wind velocity, 11.9 m.p.h.; prevailing direction of wind, W.

Sturtevant

REG. U. S. PAT. OFF.

Puts Air to Work



Sturtevant Tray-Truck Drying Equipment in a stove enameling plant. Waste heat is drawn into the dryer by the small fan and is used for drying purposes. The large fan provides dust-collecting service.

DRYERS with 75 years of air engineering experience behind them

You can get such dryers from Sturtevant... dryers designed and built to exactly meet your particular requirements... and designed RIGHT, because of Sturtevant's 75 years of air engineering experience and knowledge of drying needs.

Chemicals, rubber, sugar, soap, leather, textiles and wood are merely a few of the materials for which we have furnished drying equipment. We can furnish complete systems, including ducts and other sheet metal work, or individual items of equipment such as fans, fan and heater units, etc.

We would be glad to receive your inquiry about dryers or any of the other Sturtevant Air Handling and Conditioning Equipment listed.

B. F. STURTEVANT COMPANY, HYDE PARK, BOSTON, MASS.

Sales Offices in 40 Cities. *Plants* at Hyde Park, Mass.; Framingham, Mass.; Camden, N. J.; Sturtevant, Wis.; Berkeley, Cal.; Galt, Ont. B. F. Sturtevant Co. of Canada — Galt, Toronto, Montreal

Blowers . . . Exhausters

Centrifugal and propeller types. For ventilating, fume removal, and all other purposes. Acid Resisting Fans. High Pressure Blowers.

Air Washers

Made in several types and wide range of capacities to meet varying requirements in cleaning, cooling, dehumidifying, and humidifying air.

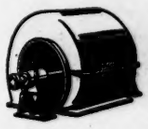
Vacuum Cleaners

Used for removing dangerous dust and for general cleaning purposes. Assure speedy, thorough cleaning and effective disposal of dust and dirt. Portable types and central systems.

Air Conditioning

Individual units of equipment or complete central systems for maintenance of desired temperature and humidity in industrial air conditioning.

Draft Equipment



Forced and Induced Draft Fans; Air Preheaters; Water Economizers; Steam Turbines; Reduction Gears. Complete units . . . undivided responsibility.

Power Roof Ventilators

Electric motor driven. Equipped with a powerful, efficient fan wheel which does a real ventilating job. Can be built of acid-resisting metals if necessary.

Unit Heaters

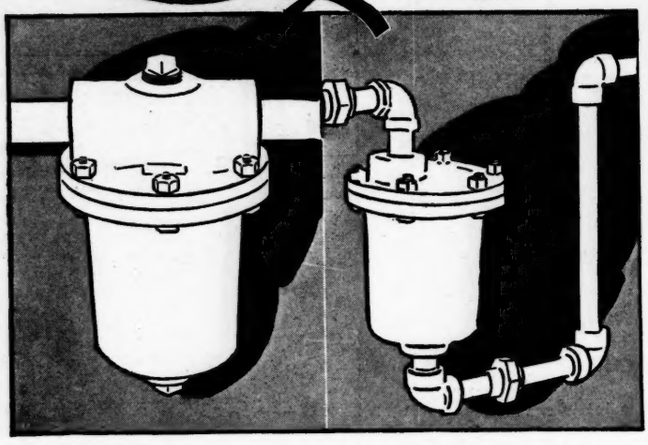
In types for ceiling, wall, or floor installation. Widest and most varied range of capacities available up to 1,500,000 B.T.U.

Electric Motors

AC and DC. Fraction and integral horsepower sizes. For general purposes and special applications.

WORLD'S LARGEST MAKER OF AIR HANDLING AND CONDITIONING EQUIPMENT

Why we say the Only COMPLETE STEAM TRAP



For this installation you buy:
1 Anderson Super-Silvertop trap. No fittings—simply install the trap as a part of the pipe.

Labor time:
Fitting 2 threaded joints.

Comment:
No unions needed since trap is inspected or repaired right on the line.

For this installation you buy:
1 old style trap
6 nipples • 4 elbows
2 unions

Labor time:
Fitting 14 threaded joints and closing 2 unions.

Comment:
Unions required since pipe must be taken apart in order to inspect or repair trap.

NO OTHER TRAP has all the advantages (listed below) that go to make Anderson Super-Silvertop a complete steam trap.

- Connect it either straight-in-line or as an elbow—no extra fittings to buy or install.
- Is inspected, cleaned or repaired without disturbing any pipe connection.
- Needs no strainer—handles ordinary dirt and scale.
- Operates on vacuum as well as pressure, proof that it does not leak steam.
- Averages 76% greater capacity than ordinary traps.
- With snap action Thermal Air Eliminator, it gives instant heat to the steam system.

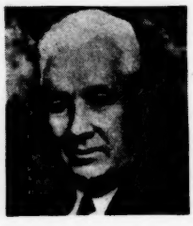
Anderson Super-Silvertop steam traps are the greatest steam trap value today because they are complete.

THE V. D. ANDERSON CO.
1943 West 96th Street • Cleveland, Ohio

Anderson **SUPER-SILVERTOP**

WITH THE MANUFACTURERS

Airtemp, Inc., Dayton, Ohio, has appointed **Charles R. Neeson** chief engineer. **R. G. Wyld** has been named executive engineer. Formerly with York Ice Machinery Corp., Mr. Neeson joined Airtemp in September, 1935. A former director of the ASRE, Mr. Neeson is responsible for the development of the company's new all-in-one air conditioner.



C. R. Neeson

R. G. Wyld

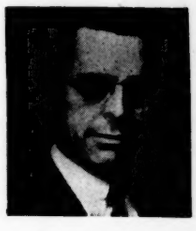
Anthracite Industries, Inc., New York, has established a permanent exhibit at the Architects' Samples Corp., 101 Park Ave., New York, N. Y.

Appalachian Coals, Inc., Transportation Building, Cincinnati, Ohio, has added **C. F. Hardy**, steam power engineer, to its fuel engineering staff. For the past eight years he was in the New Castle (Ind.) power plant of Chrysler Corp.

Bituminous Coal Research, Inc., has appointed **C. A. Reed** secretary. He succeeds **Oliver J. Grimes**, who recently resigned. Mr. Reed is in charge of the engineering department of the National Coal Association, sponsor for Bituminous Coal Research. Engineering work of both organizations are to be coordinated.

Canton Stoker Corp., Canton, Ohio, has announced its five-year stoker guarantee insuring its equipment against defects and actual wear. This guarantee is made in writing on a regular insurance certificate furnished with each installation.

W. M. Chace Co., Detroit, has appointed **Robert A. Weinhardt** to its staff, where he will specialize on the thermostatic bimetal problems of the automotive industry. Formerly assistant chief engineer of Reo Motor Car Co., he had previously served for a number of years in the engineering division of Packard, Continental Motors and Cord. This appointment is in line with the Chace Company's policy of specialized engineering for the various industries.



R. A. Weinhardt

C. I. T. Corp., New York, has opened an office in Hartsville, S. Car., in the Bank of Hartsville Building. **R. D. Rountree** is in charge.

Crane Co., Chicago, has named **J. A. Dwyer** district manager of all Crane branches in the eastern territory. Mr. Dwyer was formerly manager of the company's Philadelphia branch. **H. S. Officer**, manager of the Newark branch, succeeds Mr. Dwyer at Philadelphia and **J. H. Geiss**, moves from Hempstead, L. I., to succeed Mr. Officer at Newark.

Crane Co., Chicago, has appointed **E. L. Maim** to the heating section of the plumbing and heating department. He was formerly associated with the company's Jacksonville, Fla., branch.

Foster Wheeler Corp., 165 Broadway, New York, has appointed **Howard B. Hall** as regional director in charge of its Cleveland, Cincinnati, and Pittsburgh territories, with headquarters at 526 Superior Ave., Cleveland. Mr. Hall for the past eight years was a director of the industrial division of Murray and Flood, consulting engineers.

General Electric Co., has selected Cleveland as district headquarters for its air conditioning department. **A. J. Carmody** has been named district manager, with offices at 4966 Woodland Ave. He was formerly located in Atlanta. Mr. Carmody will supervise all G.E. air conditioning activities in Ohio, most of West Virginia, and parts of Pennsylvania and western New York.

C. H. Hall

Fairbanks, Morse & Co., Chicago, has appointed **Cortice H. Hall** to the experimental and development staff of its stoker division. Since 1922 Mr. Hall was associated with the domestic Stoker Co. and its successor, Electric Furnace-Man, Inc., as chief engineer. The company recently appointed **Sioux Steel Co.,** Sioux Falls, S. Dak., distributor for its air conditioning equipment in that territory.

General Heat and Appliance Co., Delco-Frigidaire Boston distributor, is moving into new and larger quarters at 594 Commonwealth Ave., about May 15.

The Institute of Boiler and Radiator Manufacturers, Geneva, N. Y., through its secretary, **F. W. Herendeen,** has announced the appointment of **W. B. Hughes,** manager of the automatic coal burning division, American Radiator Co., New York, as its representative and official delegate on the Committee of Ten. Mr. Hughes succeeds **Homer R. Linn,** Chicago, who has served as the representative of the Boiler Institute since the inception of the Committee of Ten; in fact, Mr. Linn was one of the original organizers of the Committee and his counsel and support in the work of the Committee has proved most valuable. He has been a prominent figure in the heating industry for many years and at present is engaged in independent consulting work on heating and engineering projects in the Chicago area.

Leland Electric Co., Dayton, Ohio, has appointed **W. B. Minch** factory manager. He will supervise the production of all Leland products. Mr. Minch was formerly with Cleveland Welding Co.

Motor Wheel Corp., Lansing, Mich., has changed the name of its oil-burning appliance division to **Duo-Therm Division** of Motor Wheel Corp. **Caroline Sales Corp.,** Greenville, N. Car., and **Commonwealth Sales Corp.,** Richmond, Va., are recently appointed distributors of the Duo-Therm line. District managers and sales representatives of the division recently attended a two-day sales meeting at the main office during which sales and advertising activities for the spring season were outlined.

Nash-Kelvinator Corp., 14250 Plymouth Road, Detroit, has elected the following officers: Chairman, **C. W. Nash;** president, **G. W. Mason;** vice-president, **H. G. Perkins;** vice-president of sales, Nash Motor Div., **C. H. Bliss;** vice-president of engineering, Nash Motor Div., **N. Erik Walberg;** vice-president of sales, Kelvinator Div., **H. W. Burritt;** vice-president of production, Nash Motor Div., **R. B. Elliott;** vice-president of purchasing, Nash Motor, **H. E. Long;** treasurer, **H. A. Lewis;** secretary, **H. J. Mellum;** assistant secretary and assistant treasurer, **G. V. Egan;** assistant treasurer, **G. H. Eddy;** comptroller, **W. R. Crosett;** assistant comptroller, Nash Motor, **L. J. Holly;** assistant comptroller, Kelvinator Div., **J. J. Timpy.**

Niagara Hudson Power Co., New York, has appointed **Ralph L. Manier** to its central division staff for coordinating all promotional activities in commercial and industrial heating and air conditioning sales. Mr. Manier was formerly industrial heat engineer for the Syracuse (N. Y.) Lighting Co., Inc. Long active in the industrial gas section of the American Gas Association, Mr. Manier this year was advanced to chairman of the section. **S. W. French** succeeds to Mr. Manier's position with the Syracuse Lighting Co.

N. E. Jennison

Penn Electric Switch Co., Des Moines, Iowa, has appointed **N. E. Jennison** senior engineer in the sales division. He was formerly instructor on oil burner installation and service in the Essex County Vocational School, Newark, N. J. Mr. Jennison will take charge of dealer service meetings and school work, and training of sales engineers.

Servel's highly economical new evaporative condenser reduces the operating costs of air conditioning systems by eliminating up to 95% of the water consumption.

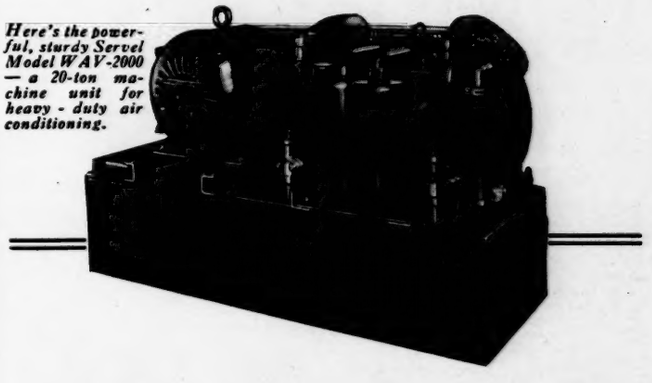
Stop

WATER WASTE!

In many regions, the condensing water for air conditioning systems costs more than the electricity used. That's why Servel products—designed particularly to reduce water consumption—are meeting with increased favor for all sizes of installations.

Servel's standard machine units—with counter-flow condensers, water-cooled heads and metering water controls — cut water costs to a minimum.

Where space permits, Servel's new evaporative condensers can be used to save up to 95% in water costs—with negligible additional expense for electricity. These economical condensers are available in five sizes to balance machine units of from 5 to 20 tons capacity.



Here's the powerful, sturdy Servel Model WAV-2000 — a 20-ton machine unit for heavy-duty air conditioning.

SERVEL

Air Conditioning **AND COMMERCIAL REFRIGERATION**

For Latest Air Conditioning News—MAIL TODAY!

SERVEL, INC., Electric Refrigeration and Air Conditioning Division, Evansville, Indiana. **(H&V-4)**

Gentlemen: Without obligation to me, please send a copy of your newest air conditioning catalog to

Name .....

Street Address .....

City ..... **State** .....

Penn Electric Switch Co., Des Moines, Iowa, has opened a new office at 333 Mutual Home Building, Dayton, Ohio, in charge of **R. V. Clark**, for the past six years manager of the company's New York office. **R. H. Luscombe**, formerly in charge of the gas control division, has been named successor to Mr. Clark in New York.

R. V. Clark

R. H. Luscombe

F. C. Russell Insulation Co., 3925 S. Hanover St., Baltimore, Md., has been formed by **F. C. Russell**, a pioneer in the development of rockwool for home insulation. The company is national in scope and is already shipping to dealers a line of products under the brand name of Rusco.

F. C. Russell

Mr. Russell entered the rockwool business in 1924 when house insulation was in its infancy. Since then he has obtained several insulation patents and has developed one of the first rockwool fabricating plants. In 1932 he was selected to develop and manage a rockwool enterprise for a large eastern concern, and in four years his leadership became an outstanding achievement in the industry. Associated with him in the development of the new company are **J. B. Russell** and **J. R. Harrason.** The former has been connected with F. C. Russell since 1925 and has been engaged in developing agencies and sales personnel. Mr. Harrason has been connected with the insulation business since 1927.

B. F. Sturtevant Co., Hyde Park, Boston, Mass., has created an **Industrial Department** to act as a liaison between the company and industrials to promote the sale and application of the company's air handling equipment. **J. C. Thompson**, formerly manager of the Washington, D. C., office, is in charge of the new department, and will make his headquarters in Boston.

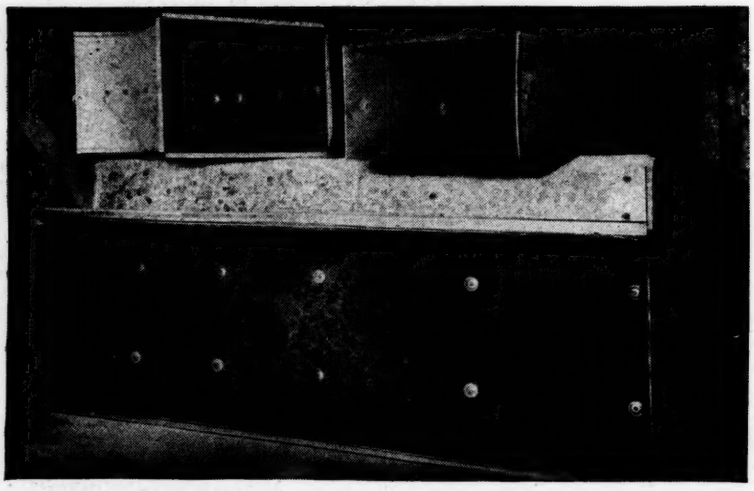
Whiting Corp., Harvey, Ill., has expanded its stoker division and made the following appointments: **Dr. W. A. Pearl** is to take full charge of production engineering. He was formerly director of shops at Armour Institute. **R. E. Young** will have charge of sales and development engineering. **B. J. Spitzka** has been named educational director and **J. A. Depew** heads a newly-organized service department. **S. M. Steinko** will take charge of advertising and sales promotion. Six sales areas of the company will be in charge of the following: **J. W. Smith**, northwest; **G. W. Warnacutt**, southwest; **R. L. Sanford**, upper central; **C. A. Geupel**, lower central; **W. F. Tilley**, northeast; **H. S. Weeks**, southeast. **R. S. Hammond** now heads the stoker division's Chicago office, with **L. M. Bang** as sales manager and **W. F. Sanford, A. Porche, C. Gardner, L. W. Olson** as representatives.

R. E. Young

The Youngstown Sheet and Tube Company's Indiana Harbor Works was host to 140 members of the Plumbing Contractors' Association of Chicago on March 11. Prior to a tour of the works the contractors were entertained at a luncheon in the company dining room. The party was welcomed to the plant by **Arthur Purnell**, the company's district sales manager with responses by **Charles E. Gawne, John J. Calnan,** and **Peter M. Munn.** The trip through the plant included a detailed inspection of nine manufacturing processes.

LINING DUCTS for Sound Absorption?

...Make sure you get FIRE and MOISTURE RESISTANCE, too!



REPORTS of fires taking hold on combustible duct linings and causing serious damage come as a warning from the National Board of Fire Underwriters!*

With life and property in danger, the use of a material that provides fire-safety, as well as sound absorption, becomes a necessity.

J-M Air Acoustic Sheets perform exactly that function. This sound-absorption material cannot burn or smolder . . . will never contribute to fire spread. And being moisture resistant, Air Acoustic Sheets are exceptionally free from the dangers of humidity.

Furthermore—their high rate of sound absorption (up to 80%) . . . light weight, assuring easy handling and application . . . the permanence of their mineral composition . . . their high transverse strength and low thermal conductivity . . . all make this material outstanding in its field. For complete data on J-M Air Acoustic Sheets, write Johns-Manville, 22 E. 40th Street, New York City.

Johns-Manville
AIR ACOUSTIC SHEETS FOR DUCT LINING

*A recent bulletin from the N.B.F.U. reports several cases in which combustible duct linings caught fire and contributed to greatly increased loss.

NEW CATALOGS

(Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.)

Alexander Brothers, Inc., Philadelphia, Pa., has published a standard-size, 32-page catalog, No. A-116, on Alexander leather products for every industrial purpose. Catalog gives horsepower ratings of monobelts, discusses the advantages of monobelts, horsepower ratings of oaktanned leather belts and presents a number of highly informative tables on such subjects as belt speeds, increasing length of belt due to crossing or difference in diameter of pulleys, half circumference of pulleys and correct distance between pulley centers.

Auditorium Conditioning Corp., 17 E. 42nd St., New York, has published a standard-size, four-page bulletin, No. 11, entitled "The Auditorium Plan and What It Means to Designers, Builders and Buyers of Air Conditioning Systems." The bulletin explains how permission to utilize the features of the Auditorium Conditioning Corporation systems can be secured and contains information relative to central station air conditioning systems and air conditioning units.

Automatic Switch Co., 154 Grand St., New York, has published a standard-size, 32-page catalog, No. 20. This catalog describes its line of solenoid operated valves for automatic and remote control of pipe lines carrying air, gas, steam and liquids. Gives prices and specifications, desirable capacities, and installation information.

Commodore Heaters Corp., 11 W. 42nd St., New York, has published three standard-size catalogs on its line of Convectofins. The first, Bulletin 10, gives information on standard Convectofin for all pipe systems of heating, while Bulletin 11 covers Simplex Convectofins for single pipe connection to steam heating systems. Bulletin 12 is on Waterflo Convectofin for hot water heating systems using mechanical circulation. Pamphlets give certified performance, range, gas tables, dimensions and typical installations.

Detroit Stoker Co., Detroit, Mich., has published a standard-size, 24-page catalog devoted to the use of Detroit stokers in prominent educational institutions, including private and parochial schools, colleges, universities and public schools in many principal cities of the United States and Canada.

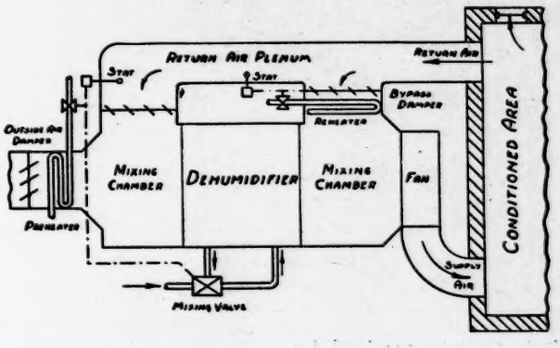
Fedders Mfg. Co., Inc., Buffalo, N. Y., has announced the publication of a catalog, No. AC-201, which illustrates and describes the new line of Fedders "All Season" air conditioning units. Catalog is standard size, punched for looseleaf, and has 36 pages. A considerable amount of useful working data as well as specifications and descriptions of the air conditioning units are included in the publication.

Hart & Cooley Mfg. Co., Holland, Mich. A standard-size, 44-page catalog, No. 37 AC, describing its line of air conditioning grilles, registers and intakes. Gives specifications, dimensions, installation information and list prices. An unusual feature is a two-page spread in the front of the book which gives a synopsis of the information contained in the catalog and shows where it can be found.

H. O. Trerice Co., 1420 W. Lafayette Blvd., Detroit, Mich., has published a standard-size, 36-page catalog, No. 101C, on the Trerice line of temperature and pressure instruments. The company's line of equipment includes industrial thermometers, laboratory thermometers, mercury actuated and vapor actuated dial-indicating thermometers, recording thermometers, recording pressure gages, air-operated and self-operating pressure controllers and steam traps. Complete specifications and list prices are given.

U. S. Electrical Motors Inc., 80 Thirty-fourth St., Brooklyn, N. Y., and 200 E. Slauson Ave., Los Angeles, Calif., has published a standard-size, 12-page pamphlet on the U. S. Varidrive motor. This motor is said to give about 1000 different speeds at the turn of a wheel. Catalog describes the method of operation, the distinctive features and the instruction details. A number of remote control applications are also illustrated.

AN AIR CONDITIONING SYSTEM OF UNIVERSAL APPLICATION



AUDITORIUM Conditioning Corporation in this and succeeding months will bring to your attention outstanding types of air conditioning systems (*) for **HUMAN COMFORT.**

The system illustrated is found in most of the prominent air conditioning installations in the world. Leading architects and engineers consider it **STANDARD.** Its pre-eminence is based upon outstanding features, among which are—

- √ **Maximum efficiency and economy under all load conditions.**
- √ **Speedy cooling down.**
- √ **Simplicity and flexibility of control.**
- √ **Temperature and humidity always as desired regardless of occupancy or load.**
- √ **An ample supply of fresh air for ventilation requirements.**
- √ **No streaks or drafts.**
- √ **Year 'round operation — summer and winter.**

Our Licensees will be glad to consult with you regarding the engineering features of this system and also tell you about many other Auditorium Systems. (*)

American Blower Corp.
Detroit, Mich.

Buffalo Forge Co.
Buffalo, N. Y.

Carrier Corp.
Newark, N. J.

Frick Co.
Waynesboro, Pa.

General Electric Co.
Schenectady, N. Y.

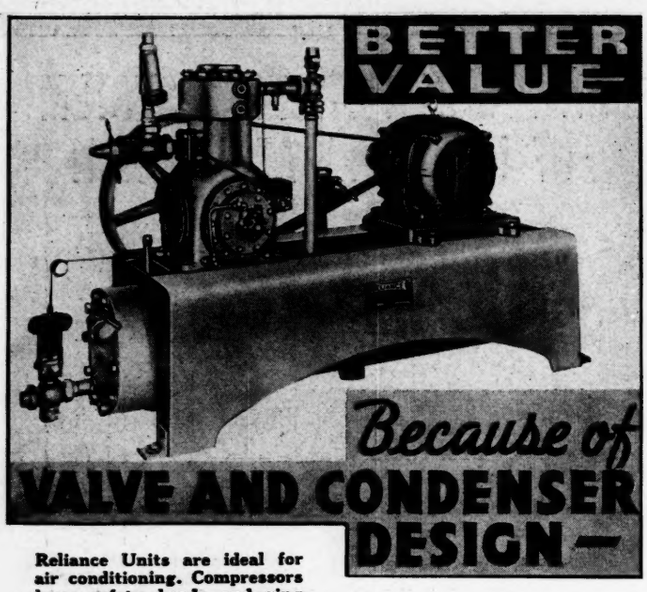
J. O. Ross Engineering Corp.
New York, N. Y.

The Cooling & Air Conditioning Corp.
Division of B. F. Sturtevant Co.
Hyde Park, Boston, Mass.

York Ice Machinery Corp.
York, Pa.

(*) *Auditorium Air Conditioning Systems are covered by many issued patents and pending applications.*

AUDITORIUM CONDITIONING CORPORATION
New York Office 17 East 42nd Street New York



Reliance Units are ideal for air conditioning. Compressors have safety heads and ring plate valves, made of fine Swedish steel. Valves have larger capacity, open and close easier and faster and are quiet in operation. Valve cages and safety heads of fracture-proof "Z" metal. Water jacketed compressors. Welded shell and tube condensers with removable heads for easy cleaning. Compressor illustrated has force feed lubrication, Timken bearings and rotary seal on shaft. For Freon, Methyl Chloride and Ammonia. Sizes 1 to 60 H.P. Write for catalog.

RELIANCE REFRIGERATING MACHINE CO.
3401 N. Kedzie Ave. CHICAGO, ILL.

RELIANCE *Units*
For Air Conditioning

AEROFIN
Heat Exchange Surface
PROVED PERFORMANCE

FOR HEATING *or* COOLING
Write for Literature
AEROFIN CORPORATION
NEWARK, N. J.

Scott-Newcomb, Inc., 1922 Pine St., St. Louis, Mo., has published a large size broadside which shows the Scott-Newcomb line of air conditioning, heating and plumbing devices.

Wade Instrument Co., 2246 Brooklyn Station. Cleveland, Ohio, has published a conveniently sized folder describing a new sketch pad set of tracing paper and a guide sheet with isometric pattern on one side and ⅛ in. squares on the other. The folder also describes adjustable irregular curves, drawing instruments, and blue print paper.

Watts Regulator Co., Lawrence, Mass., has published Catalog 37, a 20-page, standard-size catalog in color, illustrating its complete line of pressure, temperature and relief valves, reducing valves, feeders and low water cut-offs. In addition to regular catalog copy, it presents much valuable information and statistical data.

COMING EVENTS

APRIL 7-9, 1937. SECOND IOWA HEATING AND AIR CONDITIONING CONFERENCE, *Iowa State College, Ames, Iowa.*

APRIL 21-23, 1937. THREE-DAY CONFERENCE ON AIR CONDITIONING AND AUTOMATIC HEAT, *University of Wisconsin, Madison, Wis.*

MAY 17-19, 1937. 48TH ANNUAL CONVENTION OF THE HEATING, PIPING AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION, *Hotel Nicollet, Minneapolis, Minn.*

MAY 24-27, 1937. 55TH ANNUAL CONVENTION OF THE NATIONAL ASSOCIATION OF MASTER PLUMBERS, *Atlantic City, N. J. Convention headquarters at the Ambassador Hotel. In connection with the convention, The 1937 Home Comfort Exposition will be held in the Atlantic City Auditorium.*

May 25-27, 1937. SPRING MEETING OF THE AMERICAN SOCIETY OF REFRIGERATING ENGINEERS, *French Lick Springs, Ind.*

MAY 25-27, 1937. 4TH SHORT COURSE IN COAL UTILIZATION, *University of Illinois, Urbana, Ill.*

MAY 25-28, 1937. ANNUAL CONVENTION OF THE NATIONAL DISTRICT HEATING ASSOCIATION, *Detroit, Mich.*

JUNE 1-4, 1937. 31ST ANNUAL CONVENTION OF THE SMOKE PREVENTION ASSOCIATION, INC., *Hotel Pennsylvania, New York. Fuel burning and air pollution exhibition to be held in ballroom of the hotel, May 31-June 5.*

JUNE 1-4, 1937. EDISON ELECTRIC INSTITUTE MEETING, *Chicago, Ill.*

JUNE 23-26, 1937. SEMI-ANNUAL MEETING OF THE AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS, *New Ocean Hotel, Swampscott, Mass.*

JUNE 28-JULY 2, 1937. ANNUAL MEETING AND EXHIBIT OF TESTING APPARATUS, *American Society for Testing Materials, The Waldorf-Astoria, New York.*

AUGUST 3-7, 1937. POWER SHOW AND MECHANICAL EXPOSITION, *The Universal Craftsmen Council of Engineers of the World, Hotel Stevens, Chicago, Ill.*

WEEK OF SEPTEMBER 27, 1937. NINETEENTH ANNUAL CONVENTION OF THE AMERICAN GAS ASSOCIATION, *Cleveland, Ohio.*

OCTOBER 4-9, 1937. CHICAGO EXPOSITION OF POWER & MECHANICAL ENGINEERING, *International Amphitheatre, Chicago, Ill.*

OCTOBER 5-8, 1937. 66TH ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION, *New York City.*

JANUARY 24-28, 1938. FIFTH INTERNATIONAL HEATING AND VENTILATING EXPOSITION, *Grand Central Palace, New York.*

JANUARY 24-28, 1938—FORTY-FOURTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS, *New York.*

DECEMBER 5-10, 1938. THIRTEENTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, *Grand Central Palace, New York.*